1999 PROVINCIAL LEARNING ASSESSMENT IN TECHNOLOGICAL LITERACY

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Executive Summary

In November 1999, almost 3500 Grade 5, 8 and 11 Saskatchewan students from 182 schools participated in the *1999 Provincial Technological Literacy Learning Assessment*. This was the first large-scale technological literacy assessment undertaken in Saskatchewan.

Opportunities to Learn Related to Technological Literacy

A standard-setting panel representing various educational partners set provincial standards and expectations for the students' opportunities to learn related to technological literacy. Student and teacher questionnaire information indicate:

- Most Saskatchewan students do not have the expected opportunity to become technological literate by:
  - using computers in schools;
  - discussing how technology impacts on society and the environment; and,
  - discussing media literacy issues.
- Grade 5 students generally match provincial expectations in their quality of work, preparation and readiness to learn, and in their perseverance and determination to solve difficult problems. In contrast, Grade 8 and 11 students do not meet provincial expectations in these student-related opportunities to learn.
- Students report good support for learning from their parents and home environment.

Outcomes of Student Learning in Technological Literacy

The technological literacy assessment had two distinct samples in each grade tested. Sample A students completed open- and closed-response tests and submitted classroom completed work that demonstrated their ability to access, process and communicate information. Sample B students completed a performance test. The performance test had five stations that included word processing, using the Internet, using a product of technology, design and planning, and building models of technology.

In the assessment, four dimensions were used to described technological literacy. These four dimensions were:

1. Understanding, Describing and Adapting Technology;
2. Accessing, Processing and Communicating Information;
3. Responsible Citizens and Technology; and,
4. Using Technology, Including Computers.

Students could attain one of five levels of achievement in the assessment. *Level 5* is the highest and *Level 1* is the lowest. Achievement at *Level 3* or better represents good skills in technological literacy. A panel of educators and other stakeholders set expectations for the percentage of students at Grades 5, 8 and 11 that should attain each achievement level for each of the first three dimensions and for each of the five performance stations. The following is a summary of the findings.

Understanding, Describing and Adapting Technology

In this dimension, students identified, described and defined what technology means to them. Further, they explained features of, and problems with, a technology of their choice. ***Overall, Grades 5, 8 and 11 achievement met or exceeded provincial expectations in this dimension of technological literacy.***

Accessing, Processing and Communicating Information

To assess the second dimension of technological literacy, students submitted a school research project that demonstrated their skills in accessing, processing and communicating information. ***Overall, Grades 5, 8 and 11 achievement did not reach provincial expectations for this dimension.*** Specifically, the results from this dimension were most disconcerting for the provincial standard-setters. They believe that more Saskatchewan students should have better skills in this area of technological literacy.

Responsible Citizens and Technology

Students answered questions related to the impact technology has had on them personally, and on society as a whole. They had to make decisions about using, consuming and managing products of technology. Further, students were asked about what influences technological development and about personal and societal responsibilities related to technological development. ***Overall, Grades 5, 8 and 11 achievement approached, but did not meet, provincial expectations in this dimension.***

Using Technology, Including Computers

To assess the final dimension of technological literacy, students completed five performance stations. Each station took about ½ hour to complete and was designed to simulate tasks that one may encounter in real life.

Generally, Grade 5 achievement approached or met provincial expectations in this dimension of technological literacy. Grade 8 achievement met expectations in design and planning and Grade 11 achievement met expectations in word processing. For all other stations, Grade 8 and 11 achievement fell short of expectations.

The following table summarizes the student achievement in attaining the provincial standards in each of the five performance stations.

Summary of Results for Using Technology, Including Computers

Performance Station	*Grade 5*	*Grade 8*	*Grade 11*
Word Processing	↑	↓	↑
Using the Internet	↓	↓	↓
Using a Product of Technology	↑	↓	↓
Designing and Planning	↑	↑	↓
Building Models of Technology	←→	↓	↓

↑ Achievement met or exceeded provincial expectations.
←→ Achievement approached provincial expectations.
↓ Achievement fell short of provincial expectations.

OTHER FINDINGS RELATED TO STUDENTS' ATTITUDES AND ACHIEVEMENT

- Overall, there was no significant performance difference between males and females in the four dimensions of technological literacy.
- Students who have a computer at home scored significantly better than those students without a computer at home in many aspects of the assessment.
- Students who indicated they have research skills using the Internet performed significantly better in many aspects of the assessment.

I. Introduction

Our world has changed significantly this past century, and will continue to change because of the ever-continuous development of new technology. At home, at work, at play and in areas such as communication, transportation, medicine, entertainment, structural design and learning, technology has affected us all. The challenge for schools today, and in the future, is to empower students to function effectively within our dynamic technological society.

Technological literacy is much more than just knowing about and using computers. Certainly students have to be capable users of technology, but they also have to be able to seek, analyze and evaluate information, problem solve and make decisions, and be informed, responsible and contributing citizens. The goal of Technological Literacy, one of six common essential learnings threaded throughout all curricula, is to develop individuals who understand how technology and society influence one another and can use this knowledge in their every day decision making. What is desired are students who are able to analyze the technological influences on their lives and see themselves as having roles and responsibilities in shaping public policy related to technological change *(Saskatchewan Education, 1987)*.

The 1999 Provincial Learning Assessment In Technological Literacy

In November 1999, Grades 5, 8 and 11 Saskatchewan students completed questionnaires and tests providing a snapshot of their skills, knowledge, attitudes and practices related to technological literacy. This report summarizes these findings. Further, it examines factors related to students' opportunities to become technologically literate.

The provincial learning assessments in specific subject or skill areas are one source of information for the Saskatchewan Education Indicators Program. The Indicators Program draws data from many areas to create a comprehensive picture of Saskatchewan's K to 12 education system. Some of these sources are indicated in Figure 1.

Figure 1: Sources of Information for the Saskatchewan Education Indicators Program

Saskatchewan Education Indicators Program
School Achievement Indicators Program (SAIP), Council of Ministers of Education, Canada
Provincial Curriculum Evaluation Program
Provincial Learning Assessment Program
Statistics Canada Data
Pan-Canadian Indicators Program
Saskatchewan Education Internal Data Sources:
· School Grants
· Teacher Services
· Student Services
· Provincial Examinations
· Other Branches & Units
Other Data Sources
International Assessments and Surveys

Objectives of the 1999 Assessment

The objectives of the technological literacy assessment were to:

- report to the people of Saskatchewan on students' skills, knowledge, attitudes and practices in technological literacy;
- assess student achievement levels and provide baseline data for comparison in future assessments; and,
- collect information about the home and school environment contributing to students' opportunities to become technologically literate.

Student Participation

Classrooms from a random sample of 182 schools in urban, rural and northern Saskatchewan were selected. Students completed either the paper-and-pencil component or the performance-based component, not both.

To best gauge technological literacy skills of a typical Saskatchewan pupil, schools were asked to administer the assessment to students enrolled in regular English Language Arts. Almost all Saskatchewan students study English Language Arts, and therefore, it was believed that these pupils would provide the best overall profile of Saskatchewan students' skills in technological literacy.

Students in modified programs, where foundational objectives of the course have been altered, did not participate. In other words, students in special resource room programs, general Language Arts classrooms, locally-developed programs, or International Baccalaureate (I.B.) programs were not assessed. Regular program students requiring adaptations such as large-print forms, readers and scribes did participate.

Details of sample selection, sample size and sample profile are included in *Appendix A*.

Sample A Participation

- 611 Grade 5 students;
- 581 Grade 8 students; and,
- 620 Grade 11 students.

Sample B Participation

- 564 Grade 5 students;
- 573 Grade 8 students; and,
- 539 Grade 11 students.

Students' Motivation to Do Well

Students were asked to try their best to show how technologically literate Saskatchewan students are. Students' choice to do so depended on intrinsic motivation and personal satisfaction. Their work and effort on these tests did not affect their marks.

Results were reported at the provincial level only. Individual students, classrooms, schools or school divisions were not identified.

Format of the Assessment

Sample A students completed a 45-minute closed-response test assessing two dimensions of technological literacy. On a different day, these same students completed a 45-minute open-response test assessing these same dimensions. Utilizing two different test formats for the same knowledge/skill sets recognizes student differences in how they can best demonstrate their knowledge. Students' best achievement score from either the closed-response test or the open-response test was chosen to represent their achievement.

In addition to the tests, students submitted a research project from their school work that demonstrated their ability to access, process and communicate information.

Sample B students completed a 2½-hour performance station test. The test required students to rotate through five performance stations assessing their skills in using technology, including computers.

A school-designated coordinator administered the assessment in November 1999. Students completed a questionnaire about their attitudes towards, and practices in, technological literacy. Teachers answered a similar questionnaire on their beliefs, practices and perceptions related to technological literacy.

- A group of Saskatchewan teachers developed test materials for the assessment in the summer of 1998. They followed specifications set by a project team of education stakeholders and specialists.
- In spring 1999, tests were piloted in numerous urban, rural, and northern schools in Saskatchewan. Questions, problems and performance stations were then refined or replaced, and administrative procedures were modified, based on teacher and student feedback.

Limitations of the Assessment

The assessment design attempted to accommodate a wide, dynamic and balanced view of technological literacy. In the half-day test, it was not feasible to assess every aspect of technological literacy, nor to assess in great depth one particular area (e.g. produce a complete picture of students' computer skills). Consequently, some students may not have had the opportunity to demonstrate their full range of skills and knowledge in technological literacy.

Deciding Whether Student Opportunities or Outcomes are Meeting Expectations

Stakeholder representatives set standards and expectations related to:

- students' opportunities to learn; and,
- student achievement outcomes.

These representatives formed the standard-setting panel. In this report, they are identified as standard-setters or panelists. This group of parents, students, teachers, directors, curriculum writers, business people and trustees considered the full context of the assessment. They:

- reviewed factors affecting students' opportunities to learn technological literacy;
- became aware of the administrative processes for the assessment;
- attempted some of the test items and tasks;
- viewed examples of student work at various achievement levels; and,
- discussed students' opportunities and how well students should achieve.

The standards and expectations the panelists set provide a calibration for the findings from the assessment. The report presents student questionnaire and achievement information alongside the panelists' standards and expectations. Details of the standard-setting procedures can be found in *Appendix D*.

II. Opportunities to Learn Related to Technological Literacy

What is Opportunity to Learn?

Student achievement outcomes are affected not only by student ability, but also by differences in student experiences. The school, home, and student contribute to the development of skills, attitudes, values and processes enabling students to respond to the technological world around them. Providing students with the opportunity to be technologically literate citizens is a shared responsibility.

- Schools and teachers must create a safe, non-discriminating environment to support learning. They engage students in active learning, providing effective instruction using a variety of high-quality resources, and guided by good curricula.

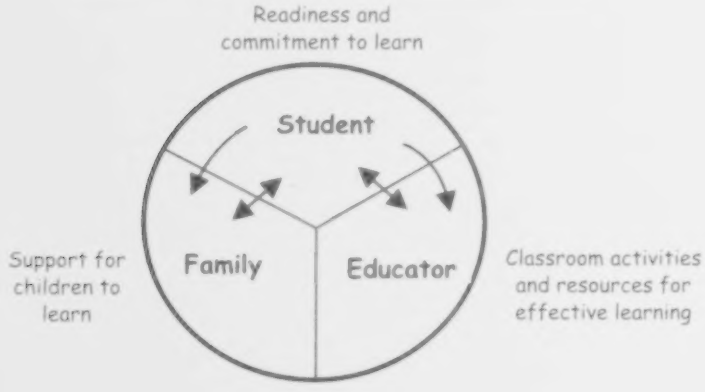
- Students must show a commitment and readiness to learn. They develop technological literacy as they choose to participate, reflect on how they might enhance their skills, and persist to do their best work.

- Parents must support their children as they learn. They discuss academic progress and school experiences with their children, promote curiosity and a desire to learn, ensure necessary resources are available, and help and encourage their children.

Opportunity to learn refers to the conditions that facilitate learning.

Outcomes describe the product or results of learning such as the skill levels demonstrated by students.

Opportunity to Learn is a shared responsibility in a social context



What Opportunity Elements Were Considered?

A variety of elements were considered in the 1999 study of opportunity to learn in technological literacy. These included:

- Classroom-related opportunities to learn:
  - time students use computers in school;
  - frequency with which they discuss how technology affects society and the environment; and,
  - frequency with which they discuss media literacy issues.

- Student-related opportunities to learn:
  - completion of assignments and their effort to show their best work;
  - preparation for class, attention to class activities and reflective practices; and,
  - student persistence when working on difficult problems.

- Family support-related opportunities to learn:
  - frequency with which they discuss how technology affects society and the environment; and,
  - home support for students' learning in general.

Separate panels, including both educators and non-educators, were formed for each of Grades 5, 8 and 11 to discuss and set standards for these opportunity elements.

Standard-setting panels reviewed and selected statements they thought best defined sufficient learning opportunity. The statements from which they could choose, along with student and teacher response rates, appear throughout this chapter. These statements describe different types of behaviour or support and do not necessarily represent equal intervals on a continuum. Because standard-setters' responses were averaged, the standard was often a decimal number. A standard of 4.3, for example, means that the standard-setters' average response fell between statement 4 and statement 5.

After setting the standard, panelists then considered the range of student needs and characteristics, their different learning styles and the different learning environments throughout the province. Based on this consideration they set a percentage expectation as to how many students at each grade level should have opportunity-to-learn consistent with the standard. These percentage expectations are presented in the tables of this section, in the row beneath the standards.

Classroom-Related Opportunities to Learn

The standard-setting panel considered three classroom-related opportunities-to-learn. For all three classroom-related elements, the panelists concluded that more students and classrooms required greater provision of opportunity.

Computer Use

Many students like to work and learn with computers. Classrooms that can integrate computers with the curriculum may find students developing a more positive attitude towards learning, students feeling more successful and students developing a better self-concept. Computer technology, when utilized effectively, has shown positive effects on achievement for all major subject areas and for both regular and special needs. This effectiveness is influenced by a number factors, some of which include the teacher's role, how students are grouped, the students' interest and background, and the level of student access to the technology.

The assessment specifically looked at student access to the technology in school. Standard-setters reflected upon and considered a regular 25-hour week of school and then set a standard for the number of hours students should use the computer during this time. Time considered on the computer included computer class-time, subject-specific research, in-school completion of assignments and other subject area uses of the computer.

Computer uses in the classroom may include:

- *Word processing*
- *Programming*
- *Researching on the Internet*
- *Drill and practice programs*
- *Tutorials*
- *Presentation software*
- *Data analysis software*
- *E-mailing experts*
- *Simulations*
- *Group project work*
- *Graphing statistical information*
- *Web Quests*
- *Video creations*

Figure 2: Time Spent Using Computers in School, by Proportion of Students, Grades 5, 8 and 11

In total, how many hours in a regular week do you use a computer at school?	Frequency (%) of Student Responses		
	Grade 5	Grade 8	Grade 11
0 - ½ hour	26.9%	21.8%	34.0%
½ - 1 hour	35.7%	31.0%	14.9%
1 - 2 hours	26.3%	28.6%	13.1%
2 - 3 hours	8.3%	14.4%	12.3%
4 or more hours	2.7%	4.1%	25.7%
Standard: Hours per week	**2.0 hours**	**5.1 hours**	**5.2 hours**
% expectation of standard-setters	**59%**	**61%**	**59%**
% of students meeting the standard	**11%**	**4%**	**26%**

Note: For Grade 8 and 11, all students indicating they spend 4 or more hours using a computer at school were assumed to have met the standard of more than 5 hours per week.

Figure 2 shows that:

- Students at higher grade levels use computers at school more extensively than students at lower grades. Almost 40 percent of Grade 11 students, 20 percent of Grade 8 students and just over 10 percent of Grade 5 students use computers at least 2 hours per week at school.

- Grade 8 and 11 students are expected to have the opportunity to use the computer about 5 hours per week and Grade 5 students about 2 hours at school.

- About one in twenty-five Grade 8's, one in nine Grade 5's and one in four Grade 11's reach the provincial standard in the amount of time students should use the computer at school.

- Most Saskatchewan students do not use computers at school as frequently as expected.

Media Literacy Discussions in Classrooms

Media influences most of our ideas about the physical, political, economic and cultural environments in which we live. We depend on media to inform our decision-making related to the issues that are important to us. Media include television, newspapers and magazines, film and video, radio, video games and the Internet. Awareness and knowledge of how media can convey ideas, information and news is crucial for students in the information age. Understanding the techniques media use to create ideas and stir emotions around issues, and critically questioning the purpose, authenticity and validity of the information being transmitted prepares our students to be informed and independent thinkers.

Standard-setters reflected upon and considered a regular subject area classroom and then were asked to set a standard for the number of times teachers should discuss media literacy issues with students in a week.

Media Literacy discussions may include:

- *Censorship*
- *Advertising practices*
- *Sources of information*
- *Pornography*
- *Information overload*
- *Subliminal messages*
- *Hate literature*
- *Visual imagining of ideas*
- *Infomercials*
- *Pop culture influences*
- *Television and its impact*
- *Newscast reporting bias*
- *Copyright of materials*

Figure 3: Media Literacy Discussions in Class, by Proportion of Students, Grade 5, 8 and 11

During a regular week how often do you discuss media literacy issues?	Frequency (%) of Teacher Responses		
	Grade 5	Grade 8	Grade 11
Never	24.1%	15.8%	14.3%
Once	43.4%	44.7%	41.6%
Twice	20.5%	17.1%	18.2%
Three times	7.2%	7.9%	13.0%
Four times	2.4%	2.6%	2.6%
More than four times	2.4%	11.8%	10.4%
Standard: Times per week	**2.7**	**3.2**	**1.9**
% expectation of standard-setters	**64%**	**69%**	**75%**
% of classrooms meeting the standard	**15%**	**21%**	**48%**

Figure 3 shows that:

- About 75 percent of Grade 5 and 85 percent of Grade 8 and 11 classrooms provide opportunity to discuss media literacy issues in class at least once per week; such discussions occur more frequently in Grade 8 and 11 classrooms than in Grade 5 classrooms.

- Grade 5, 8 and 11 Saskatchewan students are expected to have the opportunity to discuss media literacy issues in classrooms about two or three times per week.

- About one-half of the Grade 11 and about one-fifth of the Grade 5 and 8 classrooms in Saskatchewan reach the standard number discussions per week in media literacy.

- Most Saskatchewan classrooms do not engage in discussion of media literacy issues as frequently as expected.

Technology is everywhere. Society tends to view new technology as the solution to its problems, needs or wants. Many individuals embrace new technology as a panacea and believe it is wanted and needed by people. However, all technology created, whether old or new, has had social, political, cultural or economic impact on society and the environment. The awareness and understanding by students of this impact, along with thoughtful decision-making related to these issues, is necessary for thoughtful planning in the future. Discussing these complicated issues in classrooms provides the opportunity for students to come to experience and internalize some of the complexities and the decision-making processes related to these challenging issues.

Standard-setters reflected upon and considered a regular subject area classroom and then were asked to set a standard for the number of times per week teachers should engage students in discussions of how technology impacts society.

The impact of technology discussions may include:

- *Food altering and genetics*
- *Why technology is developed*
- *Physical stagnation and technology*
- *Alternative power sources*
- *Misuses of technology*
- *Global warming*
- *Technology and the apparent loss of thinking skills*
- *Unemployment & technology*
- *Resource management issues*
- *New technology versus old and replaced technology*
- *Inequality of access to technology in the world*

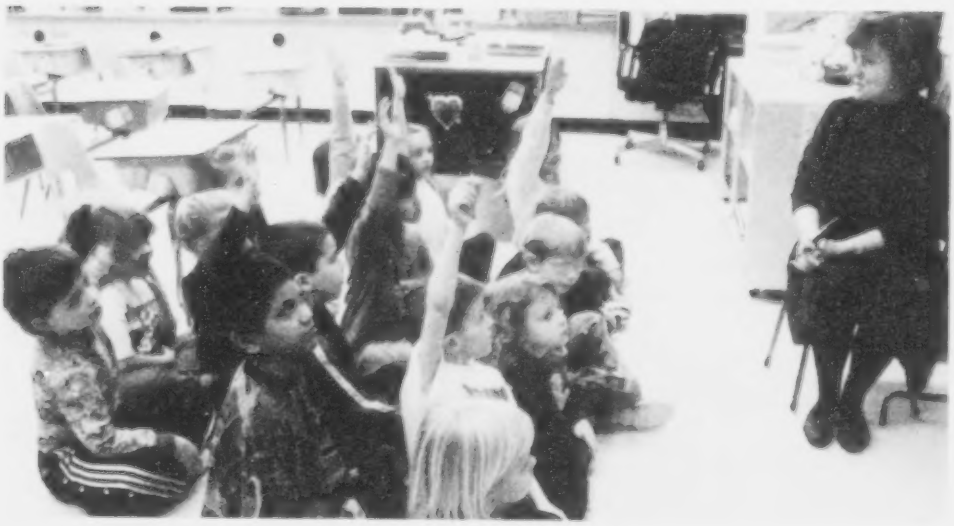


Figure 4: Discussions of the Impact of Technology on Society in Class, by Proportion of Students, Grade 5, 8 and 11

During a regular week how often do you discuss how technology affects society and the environment?	**Frequency (%) of Teacher Responses**		
	Grade 5	**Grade 8**	**Grade 11**
Never	18.5%	11.8%	7.8%
Once	35.8%	39.5%	44.2%
Twice	24.7%	23.7%	16.9%
Three times	13.6%	15.8%	19.5%
Four times	6.2%	3.9%	3.9%
More than four times	1.2%	5.3%	7.8%
Standard: Times per week	**2.6**	**3.1**	**2.0**
% expectation of standard-setters	**61%**	**66%**	**75%**
% of classrooms meeting the standard	**30%**	**23%**	**48%**

Figure 4 shows that:

- About four out of five Grade 5 classrooms and nine out of ten Grade 8 and 11 classrooms engage students in discussions about the impact technology at least once a week.

- Grade 5, 8 and 11 Saskatchewan students are expected to have the opportunity to discuss the impact of technology on society in classrooms about two or three times per week.

- Almost one-half of the Grade 11 and about one-quarter of the Grade 5 and 8 classrooms in Saskatchewan reach the standard number discussions per week related to technology and its impact on society.

- Most Saskatchewan classrooms do not engage in discussion on the impact of technology on society issues as frequently as expected.

Home Support and Opportunity to Learn

The standard-setting panel considered two home support opportunities-to-learn.

- Support for students' learning, in general; and,
- Discussions at home about the impact of technology on society.

General Support for Students' Learning

A significant factor contributing to the success students experience in school is the support they receive from their parents or guardians. Students considered and selected one of five statements on the questionnaire that described support they received from home for their learning. The nature of this support for students increased in quality from one descriptive statement to the next. Generally, panelists believed that students should have support from home that is at least consistent with the following statement:

> ***"They (parent or guardians) often talk with me about how things are going at school and encourage me whether things are going good or bad."***

Home support for learning in general, may include:

- *Providing a place for homework and quiet time*
- *Having discussions about school and learning*
- *Providing affirmation of their child's own identity and a sense of belonging to the family*
- *Reading to the child*
- *Engaging in talking circles*
- *Setting high, but realistic expectations*
- *Giving encouragement*
- *Attending parent/teacher interviews*
- *Storytelling*
- *Having an achievement wall*

Figure 5: Home Support for Students' Learning in General, Grade 5, 8 and 11

Which one of the following choices best describes how people in your home support your learning, in general?	**Frequency (%) of Student Responses**		
	Grade 5	**Grade 8**	**Grade 11**
Statement #1 – They never ask me or talk with me about how things are going at school.	4.0%	4.4%	3.8%
Statement #2 – They are only interested in how I am doing in school when things aren't going well, often getting upset with me.	8.3%	9.5%	10.1%
Statement #3 – They do not often talk with me about how things are going at school; but I know they are interested in my learning and would be willing to help, if I need help.	13.9%	19.0%	25.2%
Statement #4 – They often talk with me about how things are going at school, and encourage me whether things are going good or bad.	35.3%	37.6%	37.1%
Statement #5 – They regularly talk with me about how things are going at school, and try to help me or arrange for help, if I need it.	38.5%	29.5%	23.8%
Standard: Statement #	**3.9**	**4.1**	**3.3**
% expectation of standard-setters	**86%**	**77%**	**78%**
% of students meeting the standard	**75%**	**63%**	**79%**

Figure 5 shows that:

- Grade 5 and 8 students have a higher level of general home support for learning standard compared to Grade 11 students.

- About eighty percent of Grade 5, 8 and 11 Saskatchewan students are expected to be encouraged and have regular talks about school.

- The number of Saskatchewan students with this level of support from parents or guardians approaches or meets provincial expectations.

The Impact of Technology on Society Discussions at Home

Discussion with parents or guardians about how technology impacts society and the environment provides an opportunity for an authentic perspective for Saskatchewan students. As an example, parents discussing the importance and impact of recycling may inform children about such issues as product consumption and waste disposal. However, parents' consumer habits and actions can also further demonstrate their commitment and responsibility to these issues. Parents can reinforce what they have discussed with their children about technology issues through their actions. Through this interaction, students may come to realize they should and do have a role related to technology and its impact. Moreover, they can become responsible decision-makers and their actions can have an effect on how technology shapes their world.

Standard-setters reflected upon and considered the home life of parents and students and then set a standard for the number of times per week parents should discuss with their children how technology helps or harms society.

Figure 6: Home Discussions about the Impact of Technology on Society, Grade 5, 8 and 11

During a regular week how often do you discuss with your parents how technology (harms/helps) society and the environment?	Frequency (%) of Student Responses					
	Grade 5		Grade 8		Grade 11	
	Helps	Harms	Helps	Harms	Helps	Harms
Never	45.9%	50.8%	55.8%	61.5%	54.5%	58.6%
Once	24.1%	23.7%	23.9%	22.3%	25.6%	23.5%
Twice	13.6%	11.3%	10.3%	8.3%	10.5%	9.5%
Three times	6.3%	4.9%	5.1%	3.7%	4.5%	4.1%
Four times	3.3%	2.2%	1.4%	1.5%	1.7%	1.8%
More than four times	6.8%	7.0%	3.5%	2.7%	3.1%	2.4%
Standard: Times per week for either helps or harms society discussions	**4.2**		**2.9**		**1.8**	
% expectation of standard-setters	**67%**		**75%**		**73%**	
% of homes meeting the standard	**24%**		**23%**		**43%**	

Note: For each student, the responses to both questions were summated to determine the total number of discussions per week. It is not possible to get the percentage of homes that meet the standard by adding percentages in the "helps" and "harms" columns, as there is double counting in the responses between these two categories. If a student indicated more than four times, five discussions was used in the calculation.

Figure 6 shows that:

- Approximately one-half of the students discuss with their parents how technology helps or harms society and the environment at least once per week.
- Grade 5 students are expected to have with their parents about four discussions per week about how technology impacts society. Grade 8 students are expected to have three discussions and Grade 11 students fewer than two discussions per week on this topic.
- Approximately one-quarter of the Grade 5 and 8 students and almost one-half of the Grade 11 students reach the standard number of discussions per week with their guardians.
- Most Saskatchewan students do not discuss the impact of technology on society issues as frequently as expected.

Student-Related Opportunities to Learn

Students' opportunities to learn are shaped by attitudes, values and commitment to learn. The standard-setting panel considered three student-related opportunity-to-learn elements. It was found that Grade 5 students approached or exceeded provincial expectations in their preparation and readiness to learn, their quality of work and their perseverance and determination to solve difficult problems. In contrast, Grade 8 and 11 students did not meet provincial expectations in these three areas.

Students' Preparation for and Reflection on Their Learning

Students who prepare for class, pay attention in class and reflect upon what they have learned have a better chance of doing well in school than students who do not.

Students considered and selected one of five statements from the questionnaire that described their preparation and how they reflect on their learning. The level of their preparation and reflective practices increased in quality from one statement to the next. Overall, panelists believed the minimum standard for students should be:

> ***"I come prepared for class and work on class activities. I sometimes think about what I have done in class and how I might improve my understanding."***

Figure 7: Student Preparation and Reflective Practices, Grade 5, 8 and 11

Which one of the following statements best describes you?	**Frequency (%) of Student Responses**		
	Grade 5	**Grade 8**	**Grade 11**
Statement #1 – I am not prepared for class and pay little attention to the class activities.	3.7%	3.3%	2.7%
Statement #2 – I am sometimes prepared for class and try to pay attention, but I am often distracted or become bored and stop working on the class activities.	16.2%	16.4%	14.1%
Statement #3 – I am usually prepared for class and usually work on class activities. I rarely think about what I did in class and what I can do to improve my understanding.	25.0%	29.1%	32.3%
Statement #4 – I come prepared for class and work on the class activities. I often think about what I have done in class and how I might improve my understanding.	36.0%	40.4%	41.4%
Statement #5 – I regularly set and review goals for what I want to learn. I work on the class activities and regularly check to see how well I am doing or how I might improve to achieve my goals.	19.2%	10.8%	9.6%
Standard: Statement #	**3.9**	**4.1**	**3.8**
% expectation of standard-setters	**67%**	**74%**	**81%**
% of students meeting the standard	**58%**	**47%**	**57%**

Figure 7 shows that:

- About 80 percent of the Grade 5, 8 and 11 students are usually prepared for class and try to work on their classroom activities.
- About two out of three Grade 5, three out of four Grade 8 and four out of five Grade 11 Saskatchewan students are expected to attain the standard minimum statement of self-preparation and reflection when learning.
- Grade 5 students generally match the expected minimum level of self-preparation and reflection for their learning, however Grade 8 and 11 students do not attain the provincial expectations.

Students' Persistence and Quality of Work

Persistence refers to a student's ability to stick with a task until it is completed and the student feels that it reflects his or her best work.

Students considered and selected one of five statements that described their persistence and work quality. The descriptive statements used on the questionnaires increased in their qualitative nature for students' persistence and quality of work. Overall, panelists believed the minimum standard for students should be:

> ***"I complete most assignments, even the ones I find difficult or boring, and I usually work hard to show my best work."***

Figure 8: Student Persistence and Quality of Work, Grade 5, 8 and 11

When doing assignments, which one of the following statements best describes what you do?	Frequency (%) of Student Responses		
	Grade 5	Grade 8	Grade 11
Statement #1 – I rarely complete my assignments.	5.4%	3.2%	2.2%
Statement #2 – I complete short assignments that interest me, but often I do not work hard to complete assignments I find difficult or boring.	7.9%	8.0%	9.2%
Statement #3 – I complete most assignments, even the ones I find difficult or boring, but I usually do only as much work as necessary to get them done. I could do much better.	19.8%	26.7%	30.5%
Statement #4 – I complete most assignments, even the ones I find difficult or boring, and I usually work hard to show my best work.	42.2%	50.0%	50.1%
Statement #5 – Not only do I complete all my assignments as well as I can, I also work hard on my own projects to further my learning.	24.7%	12.0%	7.9%
Standard: Statement #	**3.9**	**4.2**	**3.7**
% expectation of standard-setters	**71%**	**74%**	**81%**
% of students meeting the standard	**69%**	**52%**	**66%**

Figure 8 shows that:

- Over 85 percent of Grade 5, 8 and 11 students complete most of their school assignments, even the ones they find difficult or boring.
- About three out of four Grade 5 and 8 and four out of five Grade 11 Saskatchewan students are expected to attain the standard minimum statement of persistence and quality of work when learning.
- Grade 5 students meet the provincial expectations for persistence and quality of work.
- Grade 8 and 11 students fall short of the provincial expectations for persistence and quality of work.

Students' Persistence in Solving Problems

Student interest and persistence to solve problems is one factor in developing their technological literacy. Students who want to understand how problems are resolved and show perseverance for developing solutions to challenging problems, provide themselves a better opportunity in developing their technological literacy.

Students considered and selected one of five statements from questionnaires that described how they problem-solve. These statements progressively distinguished from low-quality to high-quality practices and approaches in how students solve problems. Generally, panelists believed the statement that best describes a minimum standard for how students commit to solving problems should be:

> ***"I try different ways to understand and solve the problem. If I can't solve it, I get the teacher or someone else to explain it to me. I want to understand how to get the answer."***

Figure 9: Student Persistence in Solving Problems, Grade 5, 8 and 11

If you are working on a problem, which one of the following statements best describes what you do?	**Frequency (%) of Student Responses**		
	Grade 5	**Grade 8**	**Grade 11**
Statement #1 – I usually give up quickly and don't worry about it.	2.6%	3.5%	3.1%
Statement #2 – I usually give up quickly and try to get the teacher or someone else to give me the answer. I don't worry about understanding how to get the answer.	3.4%	9.3%	8.0%
Statement #3 – I usually work hard and spend a lot of time trying to get the right answer myself. If I can't get the answer, I usually get frustrated and don't try to get help.	18.5%	19.7%	19.8%
Statement #4 – I try different ways to understand and solve the problem. If I can't solve it, I get the teacher or someone else to explain it to me. I want to understand how to get the answer.	49.1%	51.1%	45.0%
Statement #5 – I look at previous examples and notes that might help me with the problem. I may ask the teacher for ideas, but I like to solve the problem myself. I make sure what I learn helps me solve other problems.	26.4%	16.3%	24.1%
Standard: Statement #	**4.0**	**4.4**	**4.0**
% expectation of standard-setters	**77.0%**	**71.8%**	**81.1%**
% of students meeting the standard	**75.5%**	**47.0%**	**69.1%**

Figure 9 shows that:

- About three out of four Grade 5, 8 and 11 Saskatchewan students are expected to attain the standard minimum statement for persistence in problem solving.
- Grade 5 students attain the provincial standard in their persistence in problem solving.
- Grade 8 and 11 students do not attain the provincial standard in their persistence in problem solving.

Other Findings Related to Opportunity-to-Learn

In addition to the above findings, other teacher and student questionnaire responses were interesting and provided more information related to Saskatchewan students' opportunity-to-learn. The following are some of these findings. The standard-setting process was not applied to these findings and the reader will have to decide if these results are sufficient or insufficient for Saskatchewan students.

Equipment and Policy

- Schools on average have about 14.9 instructional computers for every 100 students and of these 14.9 computers, 6.2 of them are classified as multimedia computers. Further, it was found that for every 100 students in schools there are 11.6 computers with Internet access.
- Schools on average have 1.7 TV/VCR units for every 100 students.
- Schools in Saskatchewan have approximately one computer projection unit for every 600 students.
- Eighty-five percent of the schools report that they have an Internet school policy, but only six percent of the schools report that they have school policy surrounding the use of pagers and cell-phones.

Computers and Learning

- Over one-quarter (28%) of Saskatchewan students reveal that computers cause them stress. The majority of the students report that teachers have taught them the most about computers and that 85% of them use the computer at least once a week to complete school assignments.
- Almost one-half (43%) of the students claim that school does not provide enough computer access time. Further, one-quarter of the students say they do not have a computer at home. Another one-quarter of the students report that they use their home computer four or more hours every week.
- Excluding computer classes, the greatest number of students utilizing the Internet is in the social studies classrooms of Saskatchewan. Conversely, the fewest number of students use the Internet in mathematics classrooms.

III. Student Achievement

Introduction

In this chapter, achievements of Grade 5, 8 and 11 students are summarized. Results are provided for:

- overall achievement for each dimension of technological literacy;
- achievement for each performance station; and,
- comparisons of achievement for identical tasks between the grades.

Sample performance stations, problems and questions are also included.

Scope and Nature of the Assessment

For the assessment, four themes or dimensions described technological literacy. These four dimensions were:

1. Understanding, Describing and Adapting Technology;
2. Accessing, Processing and Communicating Information;
3. Responsible Citizens and Technology; and,
4. Using Technology, Including Computers.

Two samples of students at three grade levels (5, 8 and 11) were administered the assessment. The first group of students (Sample A) completed both an open- and closed-response test and submitted one piece of work that demonstrated their ability to access, process and communicate information. These assessment items were assessed within the first three dimensions of technological literacy outlined above. The second group of students (Sample B) completed a performance station test. The performance test had five stations that included word processing, using the Internet, using a product of technology, design and planning, and building models of technology. The five performance stations assessed students' skills in the fourth dimension of technological literacy: using technology, including computers.

Sample A

Open- and Closed-Response Tests

- Understanding, Describing and Adapting Technology
- Responsible Citizens and Technology

Student Submission

- Accessing, Processing and Communicating Information

Sample B

Performance Station Test

- Word Processing
- Internet
- Using a Product of Technology
- Design and Planning
- Building Models of Technology

Criteria that describe five achievement levels were established for each dimension of technological literacy. *Level 5* achievement is highest and *Level 1* achievement is lowest. The tests gave students opportunity to attain any of these levels. *Appendix E* describes these five achievement levels in detail.

Other than the closed-response items, teachers scored all students' work. They examined the assessment criteria, the test items, and examples of students' work at each achievement level.

For each student in Sample A they assigned:

- an overall achievement level for Dimension 1;
- an overall achievement level for Dimension 2; and,
- an overall achievement level for Dimension 3.

For each student in Sample B they assigned:

- an overall achievement level for each performance station.

Appendix C describes the scoring procedure.

- ***Level 5*** achievement is the best and most insightful work of our most capable students.
- ***Level 4*** achievement indicates high proficiency and application skills.
- ***Level 3*** achievement is sound, good, and consistent.
- ***Level 2*** achievement represents only basic understanding and lacks consistency.
- ***Level 1*** achievement is limited and poor.

Results

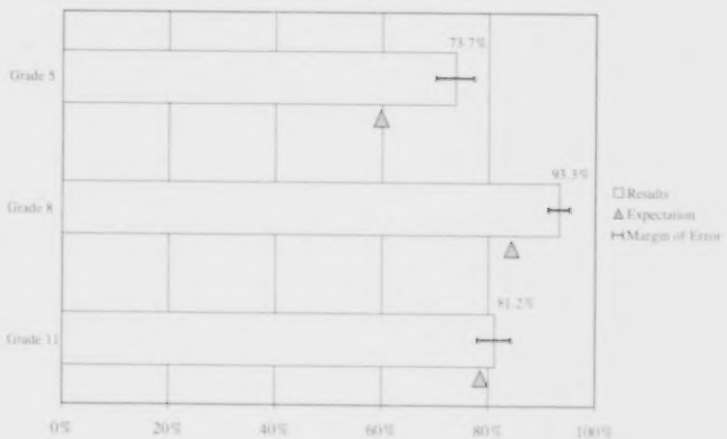
Using four dimensions provided a balanced view of technological literacy as well as a workable framework for the large-scale assessment. The following section provides the Grade 5, 8 and 11 results for the first three dimensions and each of the five performance stations.

Standard-setting panelists decided on the percent of Saskatchewan students that should be performing at a *Level 3* or above for the assessment tasks. Their decisions are represented by triangles △ on the performance achievement graphs. Performance at *Level 3* is deemed to be sound, good and consistent work.

Dimension 1: *Understanding, Describing and Adapting Technology*

Dimension 1 examined how students perceived, defined, described and adapted technology. Generally, the more broad and global perspective students had of technology, the higher achievement level they would be assigned. For example, students who viewed computers as the only example of technology would be classified as *Level 1*. On the other hand, students who viewed technology as past, present and future artifacts made by people to extend human capabilities would score a significantly higher level.

Figure 10: Understanding, Describing and Adapting Technology – Level 3 and above

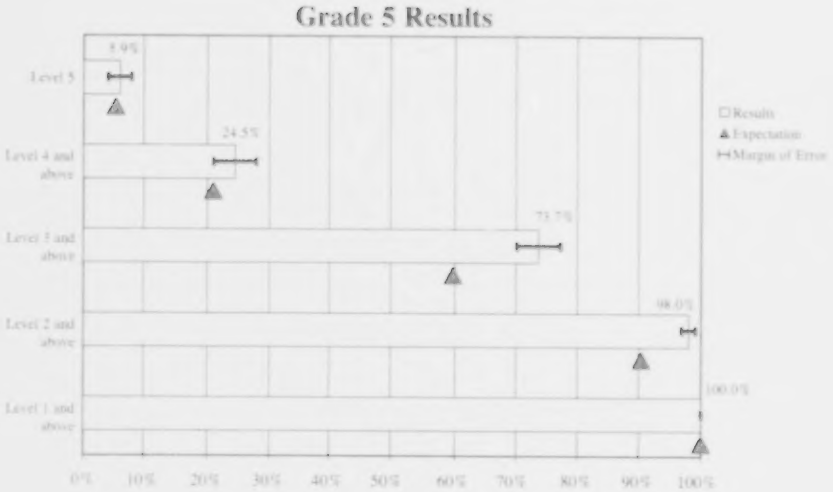


How to Interpret the Grade 5 Results from the Graph

- Approximately 60% of the Grade 5 students were expected to score a *Level 3* or better in Dimension 1.
- Approximately 73% of the Grade 5 students scored *Level 3* or better.
- ⊢⊣ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

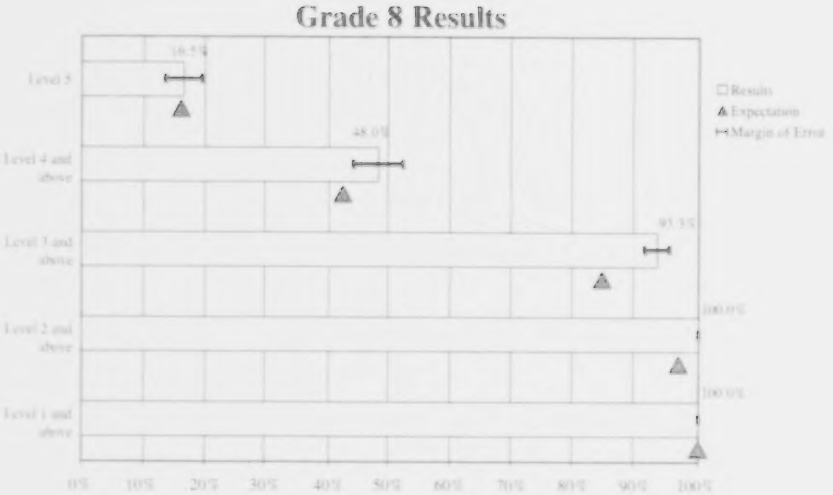
The graph above shows that Grades 5, 8 and 11 students are meeting or exceeding provincial expectations in their performance of understanding, describing and adapting technology.

Figure 11: Understanding, Describing and Adapting Technology (Accumulated Results and Expectations)



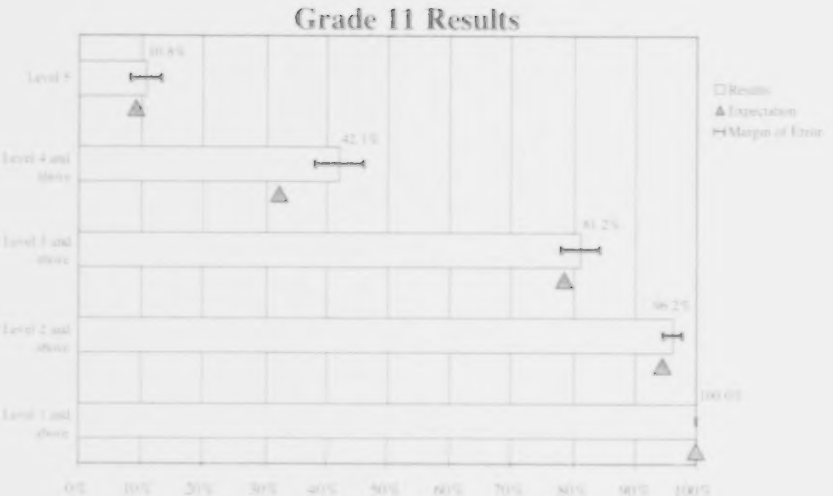
Highlights

- *Grade 5 students are meeting or exceeding expectations at all levels.*
- *Approximately 98% of the Grade 5 students are performing at Level 2 or above.*



Highlights

- *Grade 8 students are meeting or exceeding expectations at all levels.*
- *All Grade 8 students performed at Level 2 or above.*



Highlights

- *Grade 11 students are meeting or exceeding expectations at all levels.*
- *Approximately 96% of the Grade 11 students are performing at Level 2 or above.*

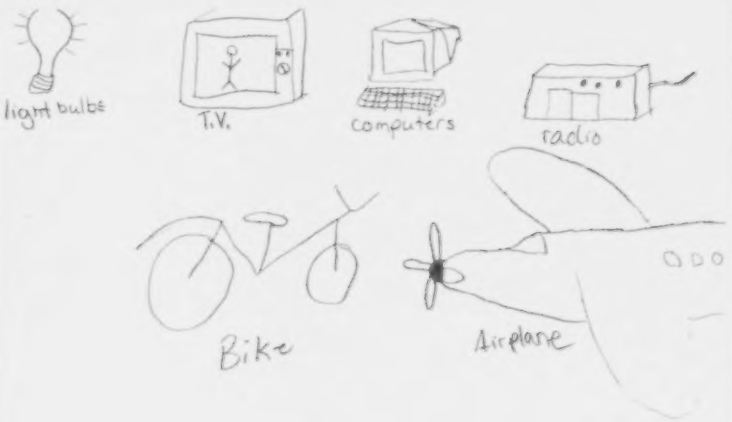
Students were given both an open- and closed-response test that assessed their understanding and abilities within Dimension 1. Scores reported used the highest level of achievement from the participant's results on either test. Students completed the closed-response test on the first day and the open-response test the second day.

A question given to all students provided a general depiction of their understanding within Dimension 1. It requested them to use words and pictures to define technology. The following is an exemplar of a *Level 5* response from a Grade 8 participant.

Grade 8 Exemplar – Level 5

- **Technology means different things to different people".**

When you read the word "**Technology**" what comes into your mind? Tell what technology means to you by drawing pictures and writing about it in the space below.



Please write your definition for technology: it is the science of objects that are used to help people in their everyday lives. The objects are improved when people get more knowledge about certain things.

Level of Performance

Level 5: *Definition is sophisticated and encompasses a full range of technology. Includes 3 criteria of product, process and reason. Provides 4 or more examples with 2 strong contrasts, one of which is simple to complex.*

Level 4: *Definition is broad, but not completely correct and includes 2 criteria of product, process and reason. Provides 3 or more examples with 2 contrasts between the technology*

Level 3: *Definition is generalized and includes 1 criteria of product, process and reason. Provides 3 or more examples with 1 contrast between the technology.*

Level 2: *Definition is vague. Provides 3 or more examples from same general area*

Level 1: *Provides 1 or 2 similar examples of technology.*

On the closed-response test there were similar questions for all students. Results from these questions show that as students progress through the school system they broaden their view and have a better understanding of what technology is. The first question on all closed-response papers asked students to identify what they believed to be true about technology. The following is a partial segment of that question.

What is Technology?

a) Check the box that indicates what you believe to be true for each item.

Item	Definitely Technology	Might be Technology	Not Technology	Don't know
Computer				
Bridge				
Clock				
Old Stone Axe				
Airplane				
River				

The item list for this question contained 28 items, of which 23 were clearly examples of technology.

Within the list of 28 items given to the students, 23 items were clearly examples of technology. For these 23 items, the more students deemed as "Definitely Technology", it was reasoned, the broader view of technology they have. The following is a grade comparison result chart on some of the items students deemed as "Definitely Technology" in the assessment.

Figure 12: Grade Comparison Results for Identifying Examples of Technology

	Percent of Students that indicated item is "Definitely Technology"		
Item	***Grade 5***	***Grade 8***	***Grade 11***
Computer	*93.3%*	*99.4%*	*99.5%*
Bridge	*22.8%*	*31.3%*	*61.9%*
Clock	*65.4%*	*73.8%*	*77.3%*
Old Stone Axe	*12.8%*	*13.6%*	*31.3%*
Airplane	*75.6%*	*86.9%*	*94.5%*
River	*10.4%*	*3.0%*	*2.0%*

It should be noted that the item *"River"* was not considered a clear example of technology for the assessment. Again, the chart shows that as students advance through the education system they expand their view and understanding of what technology is. Still, there were some items such as an old stone axe, that relatively few students, even at the higher grades, identified as technology.

A second similar question on the closed-response tests asked students the following:

Technology is

A. Similar to science
★ B. Processes and products that extend human capabilities
C. Computers, televisions, radios and other electronic devices
D. Conceptual ideas and theories of machines and artifacts

★ Accepted as the best answer.

For this question, 13% of the Grade 5's; 42% of the Grade 8's; and 62% of the Grade 11's selected the best answer. The results support the notion that as students experience more schooling, they broaden their view and understanding of what technology is.

Dimension 2: *Accessing, Processing and Communicating Information*

Dimension 2 examined how effectively students access, process and communicate information. Participating students in consultation with their teachers were asked to select and submit a research project completed in school that demonstrated these skills. The students and teachers were provided a scoring rubric for the submission. The rubric outlined the criteria for the different levels of performance within this dimension.

Submissions from students varied extensively. They included handwritten and word-processed reports, web-page designs, powerpoint presentations and video creations. Level 5 submissions generally had the following characteristics:

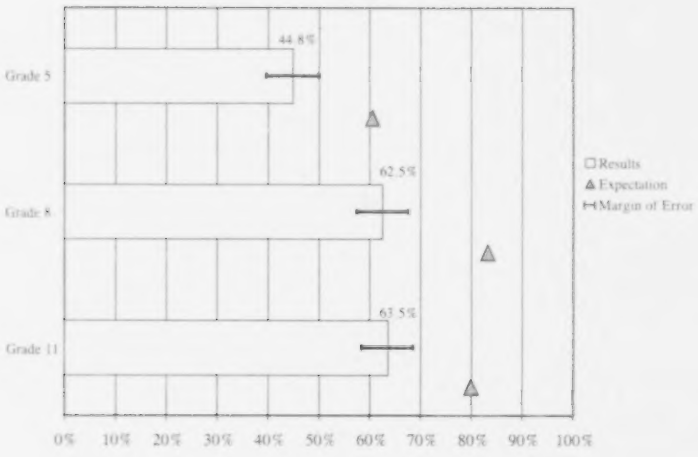
- Information that was accessed and used in the submission came from a number of different sources and was cited in a bibliography. The sources used for the submission appeared reliable.

- Information within the submission was processed clearly, thoughtfully and creatively. Sophisticated and detailed support was provided in the submission when required.

- The presentation of the submission was sophisticated and aesthetically pleasing.

See *Appendix E* for more specific details of the scoring rubric.

Figure 13: Accessing, Processing and Communicating Information – Level 3 and above



How to Interpret the Grade 5 Results from the Graph

- Approximately 60% of the Grade 5 students were expected to score a *Level 3* or better in Dimension 2.
- Approximately 45% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

The graph above shows that Grade 5, 8 and 11 students are not meeting the provincial standards in this dimension of technological literacy. Of all the performance results from the assessment, the findings from this dimension were the most disconcerting for the standard-setting panelists. They believe that Saskatchewan students should have these important skills and that extra attention should be given to improve student skills and abilities in this area.

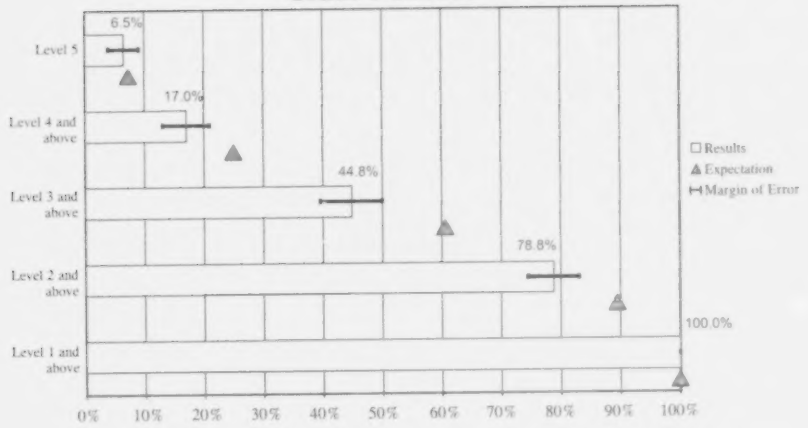
The following chart illustrates how students under-performed in the element of accessing information for their student submission. The scoring rubric provided to teachers and students before the assessment indicated that a bibliography should be included with the submission and that a *Level 5* performance in accessing information should use a number of quality media sources. The scoring rubric used for assessing submissions stated that if students used only one source of information they would achieve *Level 1*. In other words, students who scored *Level 1* probably didn't include a bibliography with their submission. Figure 14 shows that about one in three Saskatchewan students used only one source of information for their research project submissions.

Figure 14: Percentage of Students Using One Source of Information for Their Research Project Submissions, Grade 5, 8 and 11

Accessing Information	*Grade 5 (Percent Attained)*	*Grade 8 (Percent Attained)*	*Grade 11 (Percent Attained)*
Level 1	*31%*	*44%*	*35%*

Figure 15: Accessing, Processing, and Communicating Information (Accumulated Results and Expectations)

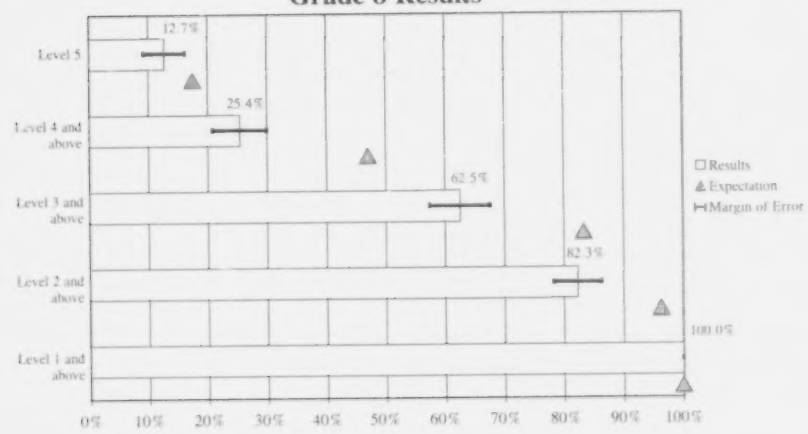
Grade 5 Results



Highlights

- *Grade 5 students are approaching expectations at the higher levels of achievement.*
- *More Grade 5 students are expected to be performing better at Levels 2 and 3.*

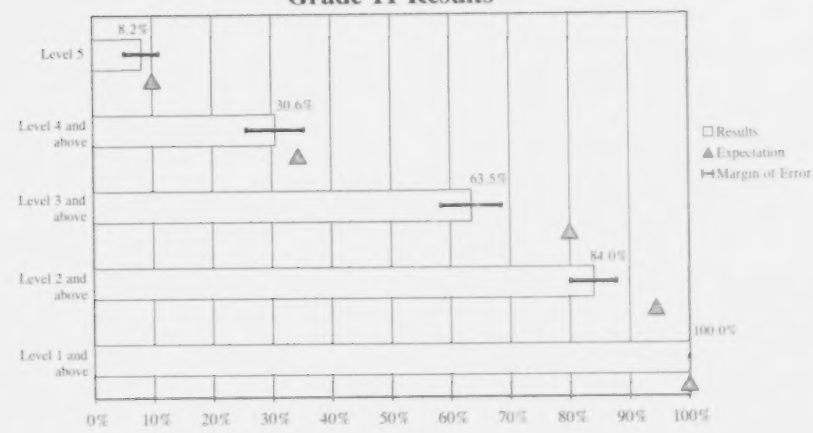
Grade 8 Results



Highlights

- *More Grade 8 students are expected to be achieving at the higher levels of performance.*
- *More Grade 8 students are expected to be performing better at Levels 2 and 3.*

Grade 11 Results



Highlights

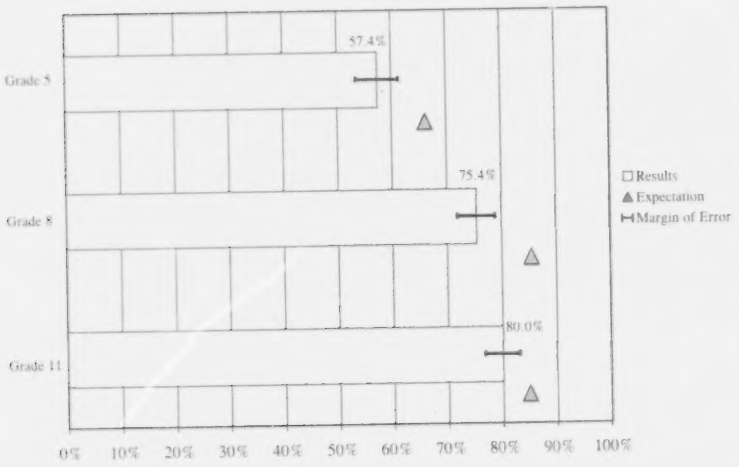
- *Grade 11 students are approaching or attaining expectations at Levels 4 and 5.*
- *More Grade 11 students are expected to be performing better at Levels 2 and 3.*

Dimension 3: *Responsible Citizens and Technology*

Dimension 3 examined how students understand and respond to the effects of technology on society and the environment. More specifically this dimension investigated:

- *How well students identify and understand the way technology impacts on them personally and on a society as a whole;*
- *How well students identify and understand the political, economic and societal influences driving technological developments; and,*
- *How well students make thoughtful and responsible decisions regarding issues surrounding technology and society.*

Figure 16: Responsible Citizens and Technology – Level 3 and above



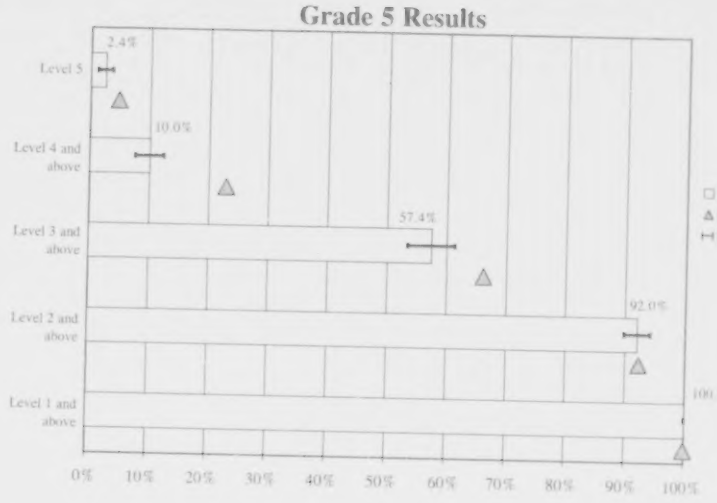
How to Interpret the Grade 5 Results from the Graph

- Approximately 65% of the Grade 5's were expected to score a *Level 3* or better in Dimension 3.
- Approximately 57% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

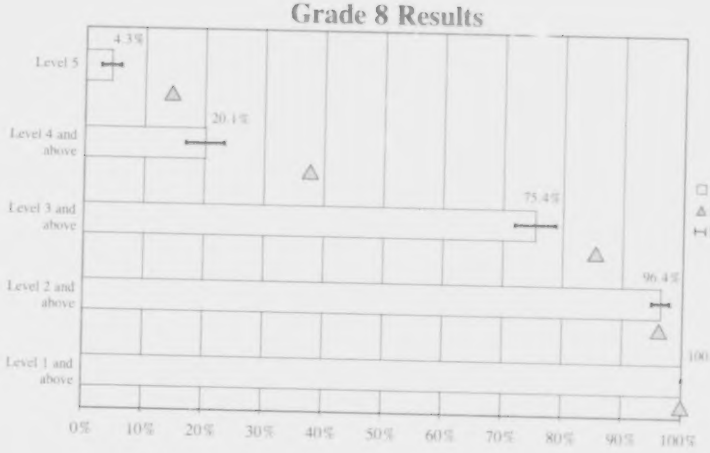
The graph above shows that Grades 5, 8 and 11 students are approaching provincial expectations in their performance in Responsible Citizens and Technology.

Figure 17: Responsible Citizens and Technology (Accumulated Results and Expectations)



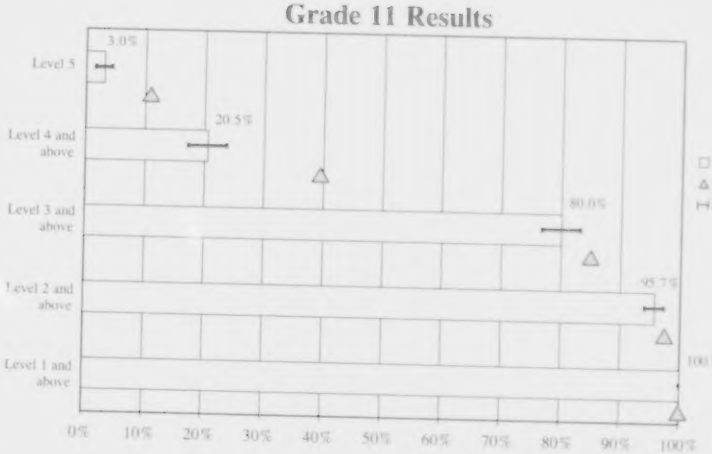
Highlights

- *More Grade 5 students are expected to be achieving at the higher levels of performance.*
- *Approximately 92% of the Grade 5 students are performing at Level 2 or above.*



Highlights

- *More Grade 8 students are expected to be achieving at the higher levels of performance.*
- *Approximately 96% of the Grade 5 students are performing at Level 2 or above.*



Highlights

- *More Grade 11 students are expected to be achieving at the higher levels of performance.*
- *Approximately 96% of the Grade 11 students are performing at Level 2 or above.*

The Nature of the Questions for Dimension 3

Students completed both an open- and closed-response test that assessed their understanding and abilities within Dimension 3. Scores reported used the highest level of achievement from the participant's results on either test. Students completed the closed-response test on the first day and the open-response test the second day.

Dimension 3 was divided into three threads or concepts pertaining to Responsible Citizens and Technology. They included:

1. *Students' ability to give reasons for technological developments;*
2. *Students' ability to identify and describe how technology affects them and society; and,*
3. *Students' ability to identify issues surrounding technology and then make responsible decisions regarding those issues.*

Open-Response Test

Thread 1: *Students' ability to give reasons for technological developments.*

All students were asked to choose an item of technology and give reasons why the item of their choice was made or developed. To score at *Level 3* or above, students had to provide two or more reasons why the technology was made. Rarely did students generalize and state their reasons as societal, political or economic forces. However, they did provide a number of concrete examples for the developments as illustrated in this Grade 5 response. This example would be scored a *Level 5* response.

Why do you think the item you described above was made or developed? State **all possible** reasons.

The computer could have been invented to, help people with their jobs to learn new things, play games for fun. to explain things. To write letters and they get their faster. To talk to other people. There are probly lots of other reasons I can't think of.

The following chart shows that as students move through the school system their awareness and ability to give reasons why technology is developed increases.

Figure 18: Percentage of Students Attaining Level 3 and Above in Providing Reasons for Technological Developments, Grade 5, 8 and 11

Thread 1	*Grade 5 (Percent Attained)*	*Grade 8 (Percent Attained)*	*Grade 11 (Percent Attained)*
Level 3 and above	47%	62%	66%

Thread 2: *Students' ability to identify and describe how technology affects them and society.*

Questions that assessed student's abilities in this thread were structured differently for the three grade levels. Generally, the Grade 5 and 8 questions were short answer that gave strong guidance and direction to the students. On the other hand, the Grade 11 participants were presented with open-ended essay questions.

Questions at the Grade 5 level addressed the impact of telephones on society. Similarly, questions at the Grade 8 level dealt with the impact of television on society. In both scenarios, questions pointed toward issues surrounding the Internet and truthfulness of information communicated over this technology. Students who scored *Level 3* or above made specific statements with valid examples supporting their arguments and students who made generalized and superficial statements were assigned *Level 2* or below.

Students at the Grade 11 level were asked to discuss their position on an open-ended question about whether they agree with the statement of ***"Technology makes the world a better place to live in!"*** The following response from one of the more capable Grade 11 students illustrates their thoughtfulness regarding technology and its impact on society.

Grade 11 - Thread 2 - Exemplar - Level 5

"Technology makes the world a better place to live in!"

Do you totally agree with the above statement? _____

Discuss in full detail, using specific examples, your viewpoint on the impact and responsibilities involving technology and technological developments.

No, I do not fully agree with the statement, "Technology makes the world a better place to live in!" many aspects of technology, in fact harm, not help, our Earth. For example motorized vehicles create pollution, deaths, and other major problems. However, they provide many people with jobs, transportation, and other effects that are positive. Technology, as a whole gives people occupations, growth, and communication advantages. Without this, how are we expected to "grow" and evolve. We can not cease technology because it is inevitable. For years, we have learned vast knowledge and we must continue to do so. In order for the world to be a better place. With wisdom, we can apply our knowledge and use it. Without the wisdom to use knowledge, it is useless.

Thread 3: *Students' ability to identify issues surrounding technology and then making responsible decisions regarding these issues.*

Students watched a short video that introduced some issues regarding technology and society. Grade 5 students viewed a news-oriented video pertaining to the issues of steroid use in the Olympic games. Grade 8 and 11 students watched a drama production called *"A Test of Time"*. In this open-ended drama, a union leader is confronted with the dilemma of whether to agree to the solution to his company's waste-disposal problem. A clean-up would mean the loss of jobs for many of his fellow employees. He must decide between jobs for his workers and a safer, cleaner environment.

The following Grade 8 participant resolved the video dilemma differently than most other participating students. The individual decided to support the factory's position of business as usual opposed to supporting the community position of a full-scale cleanup. The student's rationale and proactive suggestions outlined within their answers demonstrate a sophisticated and thoughtful offering of ideas regarding this issue.

Grade 8 - Thread 3 - Exemplar - Level 5

1. Describe what the major issues were in the video **A Test of Time**?

The main issues are that a plant has been storing barrels of leaking chemicals near an underground well. The chem may be leaking into the well and making people sick, so a comittee wants to shut the plant down. On the other hand, if the plant tries to make a full clean up, 460 people will be out of work and the town will die away.

2. Ed, the president of the local union, had to make a very difficult decision. If you were Ed and had to make the deciding vote, how would you vote? Why would you vote that way?

I would vote to support the factory, because there's a chance that only a minor clean up is needed, and because the town would still be there.

3. There are many difficult issues in society like the one presented in **A Test of Time**. What are some ways for society to solve these difficult issues?

I think we could put aside a place in every city or town for a factory, so they can safely do business without making people sick. We could also develop special filters for taps, so the chemicals couldn't hurt us if it did contaminate the water.

Generally, students who clearly identified the issue and made decisions that were consistent and supported were assigned *Level 3* or above. Grade comparison results show that students improve in their ability to identify and make responsible decisions surrounding technology issues and society as they advance through the school system.

Figure 19: Percentage of Students Attaining Level 3 and Above in Identifying Issues and Making Decisions Related to Technology, Grade 5, 8 and 11

Thread 3	*Grade 5 (Percent Attained)*	*Grade 8 (Percent Attained)*	*Grade 11 (Percent Attained)*
Level 3 and above	*42%*	*57%*	*63%*

Closed-Response Test

Questions and situations presented in the closed-response test invited students to deliberate over all the options presented. The most challenging part for the students was to select the best option to the question or situation presented. The questions were presented in a somewhat indeterminate manner to exemplify the many issues surrounding technology and society. The following questions illustrate this:

The **main** reason special effects are used in a number of commercials is A. To entertain the television audience B. To allow producers to show their creativity C. To show how technology has advanced D. To sell more product E. None of the above	***Accepted as best answer → D.*** *Percent that selected D.* *Grade 5* *48%* *Grade 8* *55%* *Grade 11* *59%*
In the early 1950's the television became available across Canada. What effects has television had? A. People have become exposed to more information B. People are less physically fit C. People have become better critical thinkers D. A and B E. All of the above	***Accepted as best answer → D.*** *Percent that selected D.* *Grade 5* *35%* *Grade 8* *38%* *Grade 11* *43%*
Plastic is widely used in our society and takes up about 20% of the landfill sites. What is society's best option(s) to deal with this problem? A. Stop all plastic materials from being produced B. Educate people about recycling C. Have deposits on recyclable plastic products D. B and C E. All of the above	***Accepted as best answer → D.*** *Percent that selected D.* *Grade 5* *52%* *Grade 8* *67%* *Grade 11* *71%*
Which of the following is a fair judgment of the effect technology has had in our world? a) Technology has made every aspect of life better b) Technology has made the world a worse place to live c) Technology has had some good points and some bad points	***Accepted as best answer → C.*** *Percent that selected C.* *Grade 5* *63%* *Grade 8* *83%* *Grade 11* *86%*

Again, the four closed-response examples above show that as students advance through the school system they do have a better understanding of the issues surrounding technology and society.

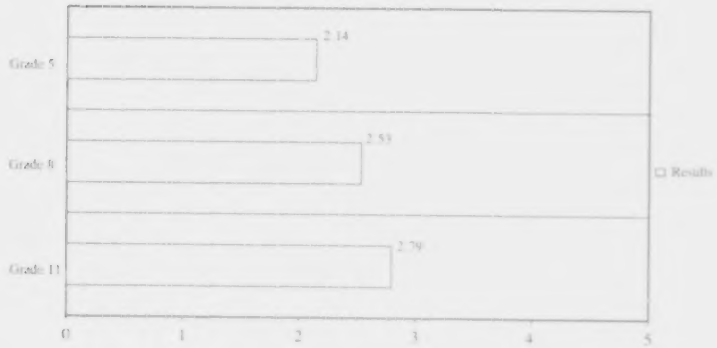
Dimension 4: *Using Technology, Including Computers*

Dimension 4 examined how well students use, problem-solve, design and *build models of technology. Students completed a 2-3 hour test that* consisted of five performance stations. Students were provided materials to complete activities in word processing, Internet searching, using a product of technology, design and planning and building models of technology. Each station allowed students to attain any one of the five achievement levels.

In this dimension, separate expectations for student performance were set for each performance station and not for the dimension as a whole. The nature of the tasks, the results and the expectations are described in this section.

The following graph shows the average student performance for Dimension 4 for students who completed a minimum of 3 performance stations. Unlike previous graphs of this nature, there are no standard-setting expectation triangles located on the graph to judge student performance.

Figure 20: Using Technology, Including Computers
(Mean Score for Students Completing a Minimum of 3 Stations)



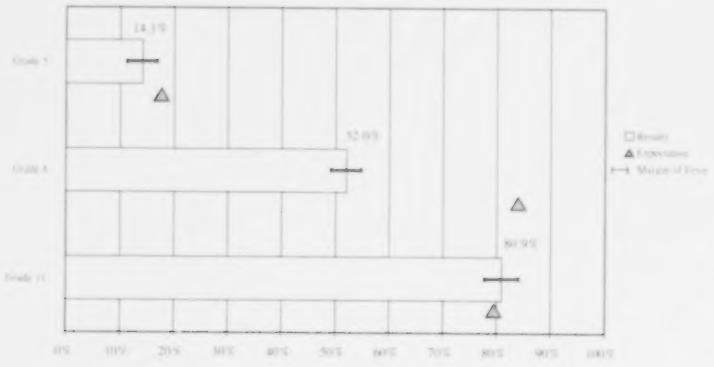
* Mean scores were calculated for students completing a minimum of three stations.

Figure 20 shows that the mean score for Grade 5 students was just above *Level 2*, Grade 8 students was approximately halfway between *Level 2* and *Level 3*, and for Grade 11 students approaching *Level 3*. Further, the graph indicates that average achievement, with a minimum of three performance stations completed, increases as students advance through the grades.

Station 1: *Word Processing*

The word processing station was the same for all grades. Students had to type in a short paragraph, about 100 words, and then save it to disk. After that, students made editing changes that included boldfacing, underlining, italicizing, centering, justifying, copying and pasting, inserting graphics, adding bullets and tables, and using headers and footers. To achieve *Level 3* or higher at the word processing station, students had to demonstrate that they could copy and paste paragraphs or use the more advanced features of a word processor.

Figure 21: Word Processing Station – Level 3 and above



How to Interpret the Grade 5 Results from the Graph

- Approximately 18% of the Grade 5 students were expected to score a *Level 3* or better in word processing.
- Approximately 14% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

The graph shows that approximately 14% of the Grade 5 students can do more than only the word processing basics. The Grade 5 results came close to, but did not reach the expectations of the standard-setters. Similarly, about one-half of Grade 8 students can do more than the basics; however, this did not meet the panelists' expectations either. Finally, about four out of five of Grade 11 students demonstrated that they have more than the basic word processing skills, which met the expectations of the educational partners.

The results indicate that students do improve their word processing skills as they advance through the school system. Further, students do attain expected levels of achievement in this area by the time they reach Grade 11. However, the data also shows that the standard-setters expected the same level of performance from Grade 8 students as Grade 11 students. The following are examples of what a *Level 1, 3* and *5* document would look like when the participant has completed the assigned word processing tasks.

Level 1

THE REGINA TORNADO
AND SASKATCHEWAN STUDENTS

Most of the windows of the new Saskatchewan Legislative Building were blown out and much of its copper roof was sent flying off into the praire. The examination papers for all the province's public schools had been stacked neetly on tables in one of the offices. The tornado answered the prayers of thousands of students when it scattered the papers like leaves on a fall day. No student in Saskatchewan had to write final exams that year.

Saved to disk as **Tornado1**

Level 3

THE REGINA TORNADO AND SASKATCHEWAN STUDENTS

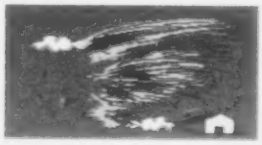
Most of the windows of the new ***Saskatchewan Legislative Building*** were blown out and much of its copper roof was sent flying off into the prairie. The examination papers for all the province's public schools had been stacked neatly on tables in one of the offices. The ***tornado*** answered the prayers of thousands of students when it scattered the papers like leaves on a fall day. ***No student*** in Saskatchewan had to write final exams that year.

(3 copies of the above paragraph saved to disk)

Saved to disk as **Tornado2**

Level 5

THE REGINA TORNADO AND SASKATCHEWAN STUDENTS



Most of the windows of the new ***Saskatchewan Legislative Building*** were blown out and much of its copper roof was sent flying off into the prairie. The examination papers for all the province's public schools had been stacked neatly on tables in one of the offices. The ***tornado*** answered the prayers of thousands of students when it scattered the papers like leaves on a fall day. ***No student*** in Saskatchewan had to write final exams that year.

- A tornado is a small circular storm
- The Regina tornado hit June 30, 1912
- Twelve people died in the Regina tornado.

Event	Date	Number of Deaths
Regina Tornado	June 30, 1912	12
Sinking of the Titanic	April 15, 1912	1503

Students performing at a *Level 5* on the Word Processing Station could complete the following tasks:

- Change font size
- Boldface, underline and italicize
- Center and justify paragraphs
- Copy and paste
- Use spell checker
- Use Save As
- Insert graphics
- Use bullets
- Insert a table
- Insert header
- Insert page numbering

Saved to disk as **Tornado3**

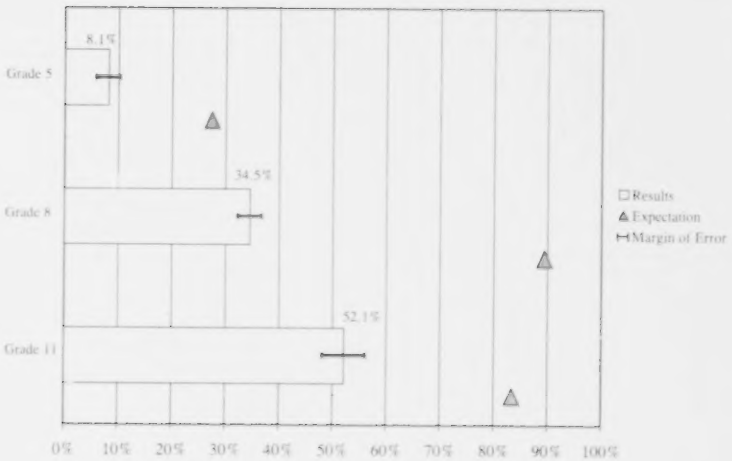
Figure 22 shows that only Grade 11 students are meeting expectations at the higher levels of achievement in word processing skills. Approximately one-half of the Grade 11's are achieving *Levels 4* and *5*, but only one in six Grade 8's and one in one-hundred Grade 5's were attaining *Levels 4* and *5*.

Figure 22: Word Processing Station - Summary of Results and Expectations

	Level 5		*Level 4+*		*Level 3+*		*Level 2+*		*Level 1+*	
	Expected	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*
Grade 5	*1.3%*	*0.0%*	*4.4%*	*0.9%*	*17.7%*	*14.1%*	*42.8%*	*51.0%*	*100%*	*100%*
Grade 8	*8.5%*	*0.9%*	*39.5%*	*14.1%*	*84.0%*	*52.0%*	*94.0%*	*90.1%*	*100%*	*100%*
Grade 11	*10.3%*	*16.8%*	*36.6%*	*50.1%*	*79.5%*	*80.9%*	*94.8%*	*94.9%*	*100%*	*100%*

All three grades did exactly the same Internet station tasks. Students demonstrated their knowledge and skills using a web browser with the Internet. To attain lower level achievement, students had to use the *BACK* icon, type in a web addresses, and use bookmarks. For students to score *Level 3* or better, they had to successfully find specific information on the Internet. The specific information they had to locate was the population of New Zealand. Acceptable values for the population was between 3 and 4 million people.

Figure 23: The Internet Station – Level 3 and above



How to Interpret the Grade 5 Results from the Graph

- Approximately 28% of the Grade 5 students were expected to score a *Level 3* or better at the Internet station.
- Approximately 8% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

Overall, all three grades did not attain the panelists' expectations for the Internet. However, the results show that students' skills and abilities using the Internet improve as they advance through the education system. Figure 24 (p.40) illustrates that students do approach or reach expectations only in their basic usage skills of the Internet and do not reach expectations when asked to find specific information. The results from this station, as with Dimension 2, were of much concern to the standard-setters. They want and expect more Saskatchewan students to develop and have Internet research skills.

Figure 24: The Internet Station – Summary of Results and Expectations

	Level 5		Level 4+		Level 3+		Level 2+		Level 1+	
	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual
Grade 5	2.1%	0.0%	7.3%	0.2%	27.5%	8.1%	77.5%	78.3%	100%	100%
Grade 8	25.0%	0.6%	61.0%	6.8%	89.5%	34.5%	96.7%	87.5%	100%	100%
Grade 11	8.4%	2.0%	35.8%	20.6%	83.6%	52.1%	96.2%	93.8%	100%	100%

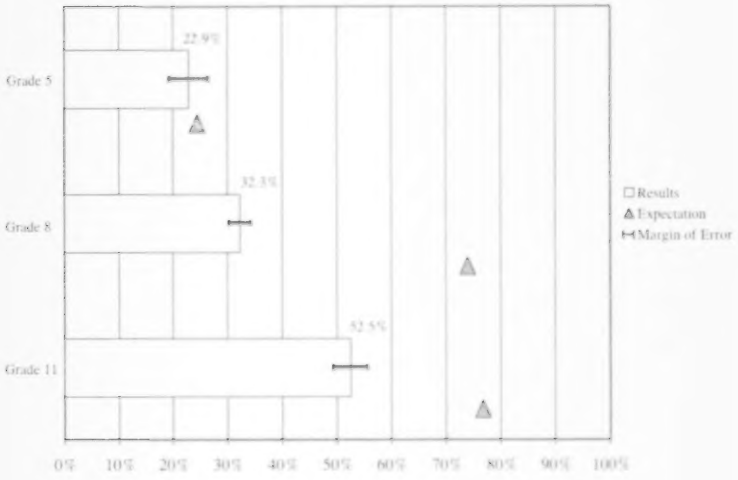
Station 3: *Using a Product of Technology*

How often have you seen a constantly flashing *12:00* on a VCR? Why is that?

The third station was designed to test student skills in following an instruction manual to use a product of technology. Instead of using a VCR though, the assessment used clock radios. The station had two main queries. First, do students have the ability to use an instruction manual to complete tasks, and second, can students use the technology to solve given problems.

Generally students could attain *Level 2* by demonstrating that they could set the radio and buzzer alarm. To achieve *Level 3* or above, students had to either show they located and used specific information related to displaying the seconds and minutes in the instruction manual or solve a problem using the technology as an aid.

Figure 25: Using a Product of Technology Station – Level 3 and above



How to Interpret the Grade 5 Results from the Graph

- Approximately 25% of the Grade 5 students were expected to score a *Level 3* or better at the Internet station.
- Approximately 23% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

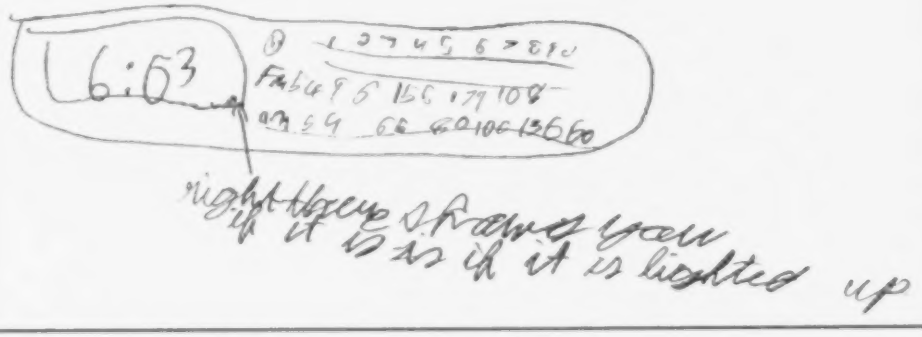
Even though the technology was the same for all three grade levels, the tasks were not. Grade 8 and 11 students completed the same set of tasks using the clock radio, but Grade 5 students used the clock radio to complete a different set of tasks. Overall, the Grade 5 students met provincial expectations; the Grade 8 and 11 students did not. Grade 11 students experienced greater success than did Grade 8 students.

Figure 26: Using a Product of Technology Station – Summary of Results and Expectations

	Level 5		Level 4		Level 3		Level 2		Level 1	
	Expected	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*
Grade 5	*2.3%*	*0.9%*	*9.3%*	*4.4%*	*24.5%*	*22.9%*	*63.7%*	*57.6%*	*100%*	*100%*
Grade 8	*12.0%*	*0.4%*	*38.0%*	*13.2%*	*74.0%*	*32.3%*	*94.0%*	*79.0%*	*100%*	*100%*
Grade 11	*9.1%*	*2.1%*	*42.3%*	*27.2%*	*76.8%*	*52.5%*	*95.2%*	*92.8%*	*100%*	*100%*

A couple of interesting findings from the clock radio station should be noted. First, all three grade levels were asked to use the instructions to set the alarm clock. From the results recorded in their test booklets, the success rate of the Grade 11 students was about 93%, the Grade 8 students was 79%, and the Grade 5 students was 58%. The following Grade 5 exemplar shows how a student might communicate their success at setting the alarm in the booklet.

How can you visually tell from the red LED display that the WAKE 2 has been set? Draw a picture to help you explain.



A second task asked students to utilize the 24-hour clock system and set their clock radios to *21 00 hours*. Only 2% of the Grade 5 students, 10% of the Grade 8 students and 17% of the Grade 11 students demonstrated that they could do this task successfully.

The following *Level 4* and *5* questions are from the last section of the Grade 8 and 11 clock radio station. Students were led through some data gathering activities to allow them to discover the speed ratios between two time setting buttons. In addition, students were given a problem in which they had to use the features of the clock radio to help them resolve it. Less than 3% of the Grade 8 and 11 students reasoned out a solution for the last problem.

Stage 4

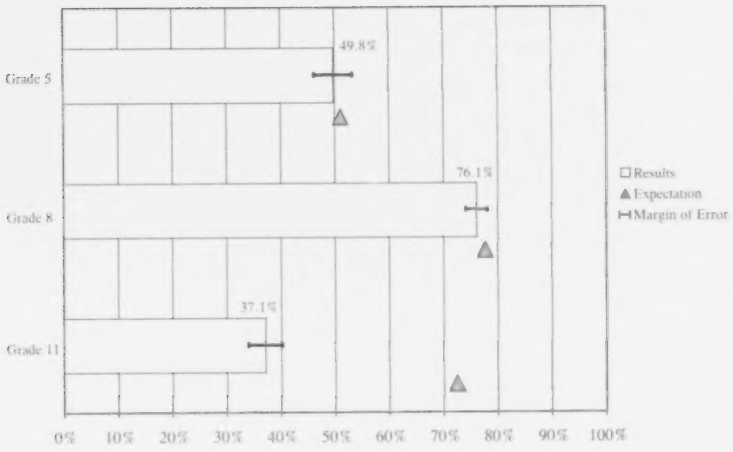
1. *Set the time of the clock to 9:00 AM.*
2. If you hold the FWD down and count for 20 seconds, what is the new reading of the clock? _____
3. How many minutes did the clock reading advance? _____
4. *Set the time of the clock to 9:00 AM.*
5. If you hold the FFWD down and count for 10 seconds what is the reading of the clock? _____
6. How many minutes did the clock reading advance? _____
7. Approximately how many times faster is the FFWD then FWD? _____
8. You are preparing to go to bed and have decided you want to wake up at 6:30 AM and listen to the radio for 2 hours straight while lying in bed. Unfortunately the clock radio is located across the room from your bed and you don't want to get up to adjust it in the morning. How can you preset the clock radio the night before to meet your needs for the next morning?

set the WAKE 1 alarm for 6:30 am and put the switch to music, set WAKE 2 alarm for 7:30 on radio.

Station 4: *Design and Planning Station*

At the design and planning station, Grade 5 and 8 students designed a plan for a schoolyard and Grade 11 students designed a plan for a small town. Overall, the Grade 5 and 8 students met provincial expectations, but Grade 11 students did not. More Grade 8 than Grade 5 students showed high level performance when designing a schoolyard.

Figure 27: Design and Planning Station – Level 3 and above



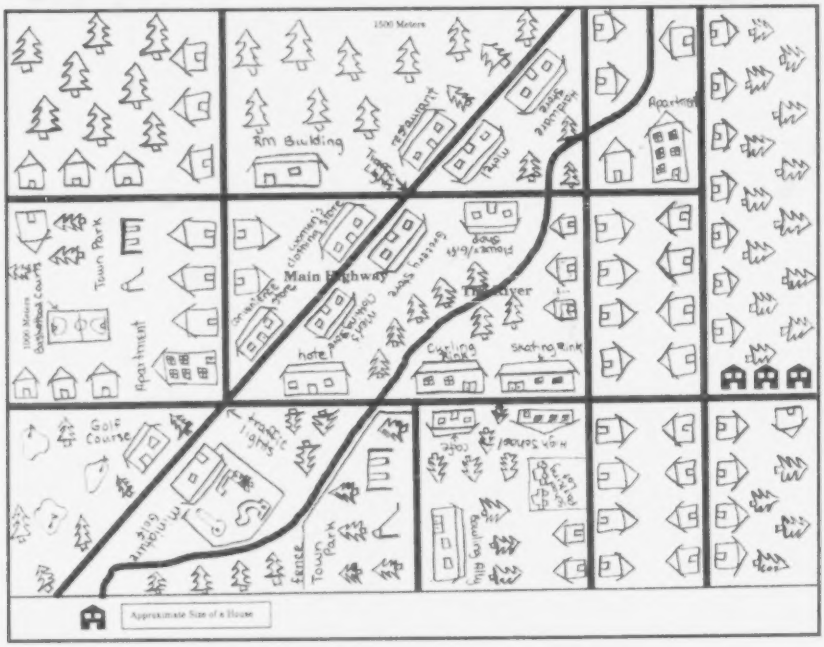
How to Interpret the Grade 5 Results from the Graph

- Approximately 51% of the Grade 5's were expected to score a *Level 3* or better at the design and planning station.
- Approximately 50% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the ▲ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

The example below, from a Grade 11 student, demonstrates how some of the more capable students addressed and engaged in the design and planning station. Unfortunately, many of the Grade 11 participants did not perform to provincial expectations at this station. Approximately one in one-hundred Grade 11's attained a *Level 5*.

Grade 11 Exemplar - Level 5



Level of Performance

Level 5: *Level 4* attained. Map is clear, realistic and attractive and includes a recreation facility and gas station.

Level 4: *Level 3* attained. Map is clear, attractive and includes a park and shopping area.

Level 3: *Level 2* attained. Map has 2 or more traffic control devices.

Level 2: *Level 1* attained. Map includes stated requirements and student states 2 design considerations for town.

Level 1: Student successfully completes the symbol chart or area chart.

Figure 28: Design and Planning Station – Summary of Results and Expectations

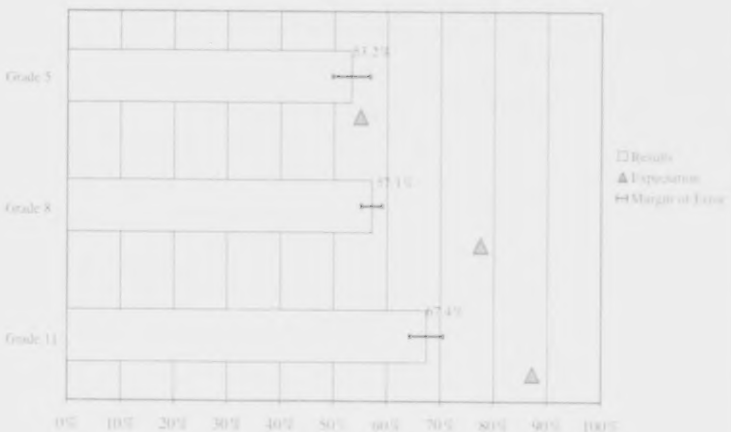
	Level 5		Level 4		Level 3		Level 2		Level 1	
	Expected	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*	*Expected*	*Actual*
Grade 5	*4.4%*	*0.4%*	*16.6%*	*7.1%*	*51.1%*	*49.8%*	*80.6%*	*77.8%*	*100%*	*100%*
Grade 8	*11.2%*	*4.0%*	*35.7%*	*27.0%*	*77.7%*	*76.1%*	*92.2%*	*91.5%*	*100%*	*100%*
Grade 11	*6.5%*	*1.3%*	*30.2%*	*16.8%*	*72.5%*	*37.1%*	*93.0%*	*68.6%*	*100%*	*100%*

A similar task for all participating students at this station was to record the length and width of the schoolyard or town. Using this length and width, students calculated the ***area*** for either the schoolyard or town. Only 41% of Grade 11 students, 38% of the Grade 8 students and 9% of the Grade 5 students could locate the length and width on the drawing and then calculate the area correctly.

Station 5: *Building Models of Technology*

This performance station was designed to simulate the situation of when one purchases an item and then has to follow instructions to build it successfully. Students demonstrated their success at this station by completing different kinds of tests on the items they built. The Grade 5 students built levers and balances and the Grade 8 and 11 built two different models of cars.

Figure 29: Building Models of Technology Station – Level 3 and above



How to Interpret the Grade 5 Results from the Graph

- Approximately 55% of the Grade 5 students were expected to score a *Level 3* or better at the building models station.
- Approximately 53% of the Grade 5 students scored *Level 3* or better.

⊢ Represents the margin of statistical error. If the △ lies within, or to the left of the margin of error, student achievement has reached or exceeded provincial expectations.

To perform *Level 3* or above, students had to demonstrate that they built the models of technology correctly. They showed this by successfully completing tests with their models. The following is the final page from a Grade 8 and 11 student exemplar for this station. Students that had built the model cars to specifications and successfully completed the designated tests successfully would have gathered data for Question 3 that was approximately double the distance of that from Question 1. This student was credited with successful completion of the models.

5. Complete the car by adding the two **small** front wheels.

Questions

1. Following the same procedures as stated on the page 14 *(rolling the car down the binder)*, measure how far the back wheels of the car travel from the base of the binder.

   How far are the back wheels from the binder? 14 cm

2. Change the smaller back wheels of the car to the larger wheels.

   What is the radius of the large wheels? 3.14 cm

3. Following the same procedures as stated on the page 14 *(rolling the car down the binder)*, measure how far the back wheels of the car travel from the base of the binder.

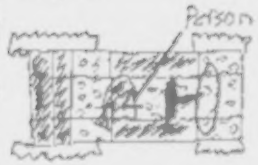
   How far are the back wheels from the binder? 35 cm

4. Why do you think there is a difference in the answers for #1 and #3 above?

   All of the smaller wheels just fit the car making the ride far and the bigger wheels were on a higher tilt making the car travel twice as fast

5. The frame of the car is not very stable. Using the materials provided in the kit, suggest how the frame could be strengthened. Draw a picture to help you explain.

   I put more beams across the two main red beams. I put in a steering wheel (that adds weight to front making it faster)



- red blocks
- yellow blocks

6. The circumference of a circle can be found using the formula: $C = \Pi \times d$

   ($\Pi = 3.14$ and $d \rightarrow$ diameter)

   Using this information estimate how many revolutions the small wheel and large wheel rotate during their ride in question #3.

   Small wheel = 9 revolutions Large wheel = 13 revolutions

7. If you had wheels that were 20 cm in diameter, how far do you estimate the car would travel and why?

   I estimate it would travel about 175cm and it would have 175 revolutions

To attain *Level 5*, students would have to reasonably estimate both the number of revolutions of the wheels in Question 6 and the distance traveled by the car if it had larger wheels. In the previous example, the student estimated the distance traveled reasonably well (about 10 times further than the model with the small wheels); however, this student incorrectly concluded that the larger wheel revolves more times than the smaller wheel. Answering questions 4 and 5 successfully resulted in *Level 4* being assigned to this work.

The results reveal that Grade 5 students met provincial expectations, but the Grade 8 and Grade 11 students did not. Further, the Grade 5 students attained or exceeded expectations at the highest levels of performance at this station. As with all other tasks in the assessment, the achievement growth for grade comparisons on similar tasks were evident.

Figure 30: Building Models of Technology Station – Summary of Results and Expectations

	Level 5		Level 4		Level 3		Level 2		Level 1	
	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual
Grade 5	8.8%	9.1%	26.6%	26.2%	55.0%	53.2%	90.0%	91.6%	100%	100%
Grade 8	10.0%	0.6%	38.5%	17.2%	77.5%	57.1%	95.0%	89.7%	100%	100%
Grade 11	8.5%	0.8%	38.5%	20.1%	87.1%	67.4%	96.9%	95.0%	100%	100%

At the building technology station, only 32% of the Grade 5 students, 69% of the Grade 8 students and 77% of the Grade 11 students could accurately measure a particular piece of LEGO to within ± 2 mm. Secondly, only one in five Grade 8 students and two in five Grade 11 students could measure the radius of a wheel successfully.

IV. Student Achievement, Attitudes, and Practices

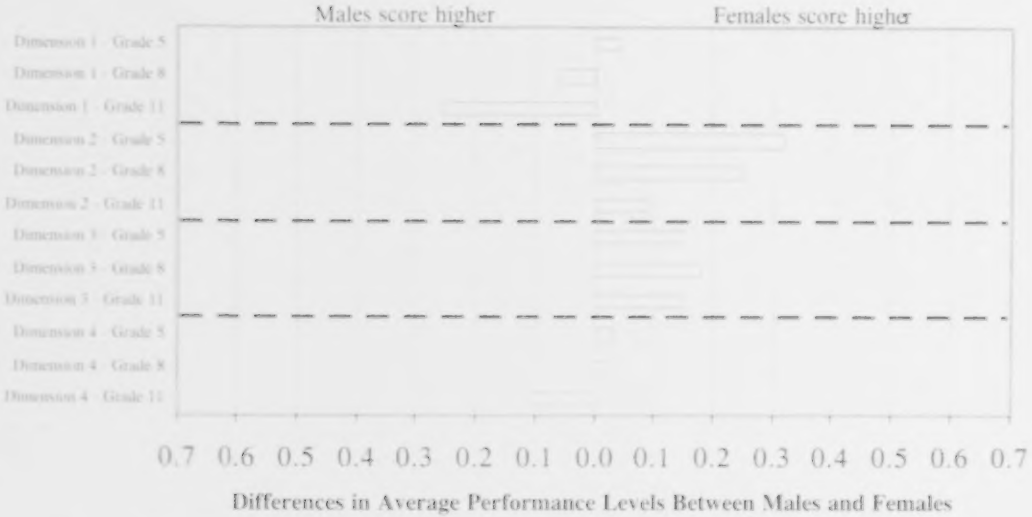
This chapter examines:

- gender differences in student achievement;
- achievement differences between students with or without a home computer;
- achievement differences of students related to their self-perception of learning technology;
- achievement differences of students related to their Internet research skill; and,
- students' attitudes and practices in technological literacy.

Gender Differences in Achievement

There were 1489 males (48.6%) and 1575 females (51.4%) who participated in the assessment. For the most part, male and female students performed similarly on this assessment. One statistically significant difference occurred in students' understanding, describing and adapting technology (Dimension 1), where Grade 11 male students achieved higher average performance levels than Grade 11 female students. Otherwise, females did as well or better in many of the tasks within the assessment. The following graph shows the performance level difference between male and female average achievement scores in the four dimensions of technological literacy. The Dimension 4 comparisons are based on the mean scores for students completing a minimum of three stations.

Figure 31: Gender Differences in Student Achievement


Males score higher
Females score higher
Dimension 1 - Grade 5
Dimension 1 - Grade 8
Dimension 1 - Grade 11
Dimension 2 - Grade 5
Dimension 2 - Grade 8
Dimension 2 - Grade 11
Dimension 3 - Grade 5
Dimension 3 - Grade 8
Dimension 3 - Grade 11
Dimension 4 - Grade 5
Dimension 4 - Grade 8
Dimension 4 - Grade 11
0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Differences in Average Performance Levels Between Males and Females

Note: Bars represent the difference in the average performance level between males and females. For example, Grade 11 males scored on average 0.26 of a level higher in Dimension 1 than Grade 11 females.

Indicates difference is significant

Indicates difference is not significant *(overlapping of confidence interval test)*

Technology, Self-Perception and Achievement

Saskatchewan students have many choices for how they spend their out-of-school time. Figure 32 shows participation rates for three popular activities during a regular week. The table shows that more students devote time to watching television and playing sports than playing video games. Further, fewer Grade 11 students spend time playing video games compared to Grade 5 and 8 students.

Figure 32: Percentage of Students that Watch Television, Play Video Games and Play Sports, Grade 5, 8 and 11

Students that devote 6 or more hours in a regular week to ...	*Percentage of Grade 5*	*Percentage of Grade 8*	*Percentage of Grade 11*
watching television	*68%*	*73%*	*65%*
playing video games	*44%*	*35%*	*22%*
playing sports	*52%*	*62%*	*53%*

Having access to technology will have an impact on the time spent using the technology. In Saskatchewan, students have varying access and utilization levels for different technology. Generally, access to technology is better for students in Grade 11 than for students in Grades 5 and 8.

Approximately three-quarters of the students in Grades 5, 8 and 11 have a computer at home. The greatest difference in the proportion of students from different grades is found in their access to and use of e-mail. Only one-third of Grade 5 students access and use e-mail, while almost two-thirds of the Grade 8 and 11 students do.

Figure 33: Student's Access to Various Technology, Grades 5, 8 and 11

Students that indicate they ...	*Percentage of Grade 5*	*Percentage of Grade 8*	*Percentage of Grade 11*
have their own television	*44%*	*48%*	*49%*
have and use a discman	*40%*	*54%*	*59%*
have and use a cellular phone	*26%*	*22%*	*29%*
have and use e-mail	*33%*	*59%*	*60%*
shop and buy on the Internet	*8%*	*8%*	*10%*
have a home computer	*72%*	*76%*	*77%*

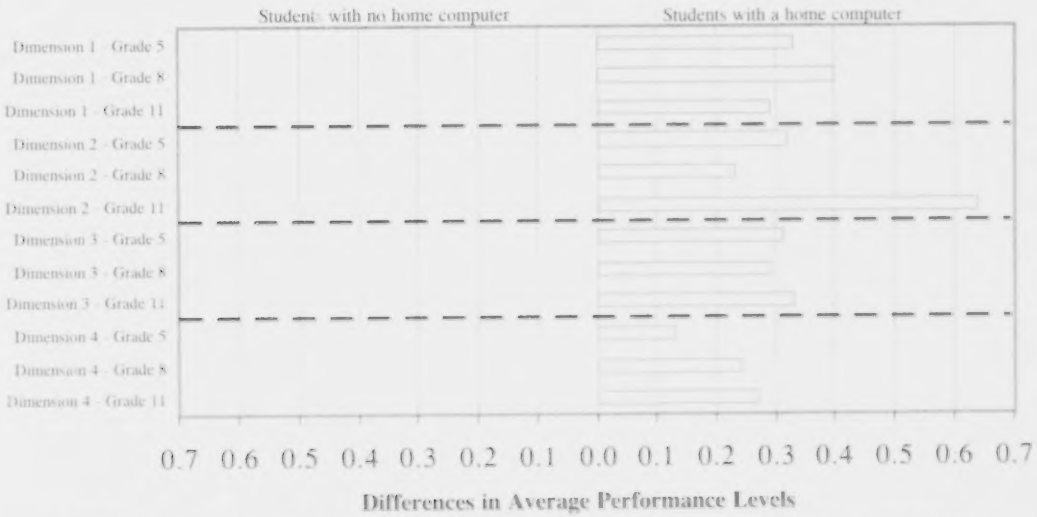
Students that indicated they have a computer at home scored significantly better than students without a computer at home in the following areas:

- Dimension 1, Dimension 3 and the word processing station (Grades 5, 8 and 11);
- Dimension 4 (Grades 8 and 11); and,
- Dimension 2 and the Internet station (Grade 11).

Although these findings from the assessment may be useful to discuss, one must take care in any attempts to establish causal relationships. A number of intervening factors, including socioeconomic status, may be at play. To suggest that the simple presence of a home computer promotes improved student achievement is most likely false and ignores the complexity of the learning process. However, it is useful to entertain discussion around the opportunities home computers can provide to students and the types of home computing activities that might best support student learning and skill building.

Figure 34 illustrates the achievement differences between students without a home computer with those that do in the four dimensions of technological literacy.

Figure 34: Achievement Differences Between Students With or Without a Home Computer


Students with no home computer
Students with a home computer
Dimension 1 - Grade 5
Dimension 1 - Grade 8
Dimension 1 - Grade 11
Dimension 2 - Grade 5
Dimension 2 - Grade 8
Dimension 2 - Grade 11
Dimension 3 - Grade 5
Dimension 3 - Grade 8
Dimension 3 - Grade 11
Dimension 4 - Grade 5
Dimension 4 - Grade 8
Dimension 4 - Grade 11
0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Differences in Average Performance Levels

Note: Bars represent the difference in the average performance level between students with a home computer to those students without a home computer. For example, Grade 11 students with a home computer scored on average 0.64 of a level higher in Dimension 2 than Grade 11 students who do not have a home computer.

Indicates difference is significant

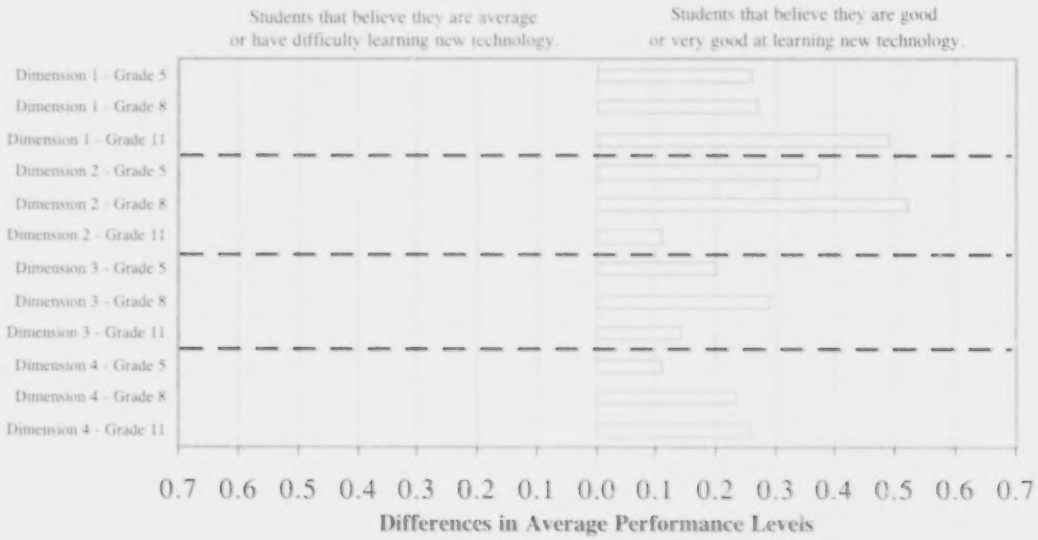
Indicates difference is not significant *(overlapping of confidence interval test)*

Most students (96%) believe that knowing how to use a computer is important. Approximately 90 percent of the students believe concepts and skills related to the computer are taught in school to prepare them for future jobs. However, only 71 percent of the students agree that computers are used in schools to faciltate working with others on group projects.

Although over one-quarter of the student participants claimed computers cause them stress, about four out of five say they use a computer at least once a week to complete school assignments. Just over half of the students indicated they were good or very good at learning new technology and about three-quarters of the participants claimed they were confident learning new things with a computer.

Students that indicated they were good or very good at learning new technology scored significantly better in almost all aspects of the assessment. Figure 35 shows these differences.

Figure 35: Achievement Differences Related to Students' Perception of Their Skill in Learning New Technology


Students that believe they are average or have difficulty learning new technology.
Students that believe they are good or very good at learning new technology.
Dimension 1 - Grade 5
Dimension 1 - Grade 8
Dimension 1 - Grade 11
Dimension 2 - Grade 5
Dimension 2 - Grade 8
Dimension 2 - Grade 11
Dimension 3 - Grade 5
Dimension 3 - Grade 8
Dimension 3 - Grade 11
Dimension 4 - Grade 5
Dimension 4 - Grade 8
Dimension 4 - Grade 11
0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Differences in Average Performance Levels

Note: Bars represent the difference in the average performance level between students that believe they are good or very good at learning new technology to students that do not. For example, Grade 8 students who believe they are good or very good at learning new technology scored on average 0.52 of a level higher in Dimension 2 than Grade 8 students who believe they are average or have difficulty learning new technology.

Indicates difference is significant

Indicates difference is not significant *(overlapping of confidence interval test)*

Computer Skills, Research Skills and Differences in Achievement

Saskatchewan students report they have varying skills and knowledge related to computers. Further, they have different perceptions of what they want to learn with respect to computers and information technology. Generally, Saskatchewan students indicated they have keyboarding and word processing skills, they know how to use the Internet for research and they know how to use e-mail. On the other hand, Saskatchewan students indicated they would like to learn more about web page design, graphics and animation, and programming. The following chart summarizes these students' skills and wants.

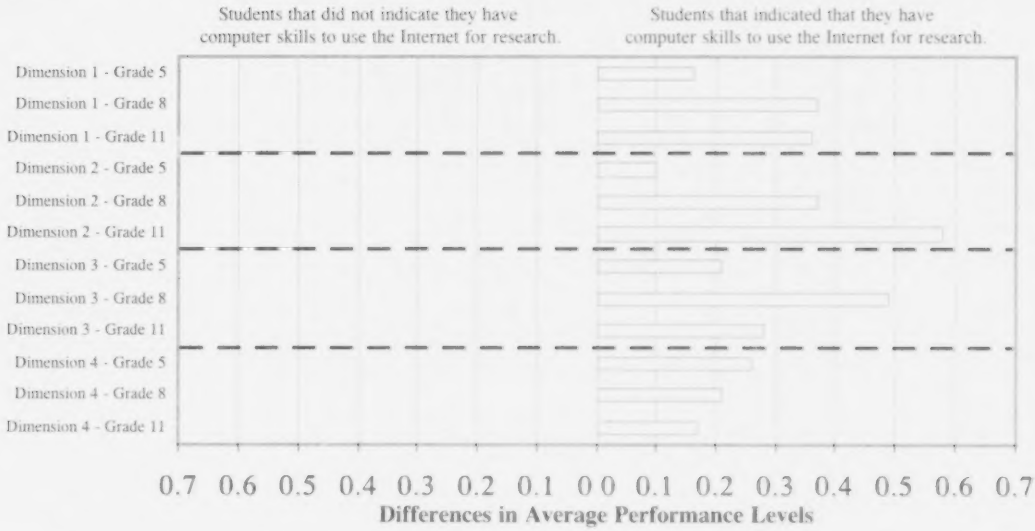
Figure 36: Student's Learning Skills and Wants Related to Computers

Percentage of students that indicated they have designated skill.			**Skill**	*Percentage of students that indicated they want to learn more about the skill.*		
Grade 5	*Grade 8*	*Grade 11*		*Grade 5*	*Grade 8*	*Grade 11*
76%	*78%*	*85%*	***Keyboarding***	*30%*	*22%*	*14%*
67%	*77%*	*81%*	***Using Internet for research***	*32%*	*20%*	*19%*
60%	*71%*	*83%*	***Word Processing***	*34%*	*21%*	*15%*
46%	*72%*	*72%*	***Email***	*47%*	*26%*	*23%*
35%	*40%*	*37%*	***Graphics and animation***	*52%*	*54%*	*61%*
14%	*34%*	*62%*	***Spreadsheets***	*50%*	*35%*	*20%*
36%	*37%*	*37%*	***Programming***	*51%*	*48%*	*47%*
26%	*32%*	*37%*	***Web page design***	*60%*	*61%*	*57%*
32%	*34%*	*32%*	***How to buy a computer***	*46%*	*37%*	*34%*
24%	*31%*	*34%*	***Multimedia***	*47%*	*40%*	*37%*
14%	*22%*	*48%*	***Databases***	*54%*	*45%*	*29%*
22%	*23%*	*21%*	***Computer maintenance***	*48%*	*44%*	*43%*
19%	*20%*	*21%*	***Computer careers***	*47%*	*47%*	*43%*

Almost all Saskatchewan students (96%) report that it is important to know how to find and use information. However, about one in six students indicated they did not like using the Internet. In addition, almost two-thirds of the students stated they use the Internet to help them complete school assignments and about one-third of the students claimed they download software from the Internet and log onto chat lines.

Approximately two-thirds of the Grade 5 participants and about four-fifths of the Grade 8 and 11 students report they can use the Internet for research. Students that self-reported Internet research skills scored significantly better in almost all aspects of the assessment. On the following page, Figure 37 illustrates these differences.

Figure 37: Achievement Differences of Students Related to Their Internet Research Skills


Students that did not indicate they have computer skills to use the Internet for research.
Students that indicated that they have computer skills to use the Internet for research.
Dimension 1 - Grade 5
Dimension 1 - Grade 8
Dimension 1 - Grade 11
Dimension 2 - Grade 5
Dimension 2 - Grade 8
Dimension 2 - Grade 11
Dimension 3 - Grade 5
Dimension 3 - Grade 8
Dimension 3 - Grade 11
Dimension 4 - Grade 5
Dimension 4 - Grade 8
Dimension 4 - Grade 11
0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7
Differences in Average Performance Levels

Note: Bars represent the difference in the average performance level between students that believe they have Internet research skills to students that do not. For example, Grade 11 students that believe they have Internet research skills scored on average 0.58 of a level higher in Dimension 2 than Grade 11 students who did not indicate they have these skills.

Indicates difference is significant

Indicates difference is not significant *(overlapping of confidence interval test)*

Finally, Saskatchewan students indicated the subject areas in which they use the Internet and computers. Substantial percentages of students report using computers in all areas of study, but more commonly in language arts. The Internet is used by most students in social studies, but it is also used frequently in science and language arts (Figure 38).

Figure 38: Use of the Internet and Computers in Different Subject Areas

Percentage of students that indicated that they use the Internet in designated class.			***Class***	***Percentage of students that indicated they use a computer in designated class. (Not Internet)***		
Grade 5	*Grade 8*	*Grade 11*		*Grade 5*	*Grade 8*	*Grade 11*
24%	*34%*	*48%*	***Language Arts***	*55%*	*62%*	*53%*
10%	*6%*	*3%*	***Mathematics***	*48%*	*50%*	*45%*
40%	*52%*	*52%*	***Social Studies***	*41%*	*47%*	*44%*
28%	*35%*	*40%*	***Science***	*38%*	*42%*	*40%*
9%	*13%*	*11%*	***The Arts***	*40%*	*46%*	*39%*
13%	*19%*	*12%*	***Health / Wellness***	*36%*	*43%*	*37%*
8%	*6%*	*10%*	***Physical Education***	*41%*	*49%*	*41%*
6%	*11%*	*9%*	***French***	*38%*	*47%*	*40%*

What Teachers Say

- Almost one-half (46%) of the teachers say they utilize and are satisfied with the use of computers and software programs as a resource for student learning in their classroom.

- Almost two-thirds (64%) of the teachers claim they utilize and are satisfied with the use of the Internet as a resource for student learning in their classroom.

- Almost two-thirds (62%) of the teachers indicate they personally use a computer three or more hours per week.

The majority of teachers report they have access to computers and the Internet at home. They also feel confident working with computers and have and use an e-mail account. However, they would like more professional development in the area of integrating computer technology through the curriculum (Figure 39).

Figure 39: Teacher Confidence, Use, Needs and Access Related to Computer Technology, Grade 5, 8 and 11

Teachers report:	Frequency (%) of Teacher Responses		
	Grade 5	Grade 8	Grade 11
I feel confident working with computers	66%	74%	70%
I have a computer at home	77%	89%	80%
I have Internet access at home	60%	69%	63%
I have and use an e-mail account	77%	86%	85%
I need more professional development in how to integrate computer technology	64%	59%	51%

Most teachers indicate they are either self-taught or have learned computers through experience in university courses or teacher inservice opportunities.

Figure 40: Percentage of Teachers Indicating Where They Have Learned the Most about Computers, Grade 5, 8 and 11

Who has taught you the most about computers?	Frequency (%) of Teacher Responses		
	Grade 5	Grade 8	Grade 11
Family members	8%	10%	4%
University courses, inservice, etc.	30%	16%	13%
Friends	25%	15%	9%
Myself	37%	59%	74%

Teachers report that they had significant knowledge and skills in word processing, keyboarding, researching using the Internet, and using e-mail. They would like to learn more about web-page design, multimedia applications and computer maintenance (Figure 41).

Figure 41: Percentage of Teachers Indicating Their Skills, Knowledge and Desire to Learn More Computer-Related Skills, Grade 5, 8 and 11

	Frequency (%) of Teacher Responses		
Teachers have skills and knowledge in ...	**Grade 5**	**Grade 8**	**Grade 11**
Word processing	89.5%	96.4%	92.8%
Researching using the Internet	80.7%	90.9%	87.3%
Using e-mail	78.9%	89.1%	85.5%
Teachers would like to learn more about ...	**Grade 5**	**Grade 8**	**Grade 11**
Web-page design	71.7%	59.6%	54.0%
Multimedia	60.4%	67.3%	54.0%
Computer maintenance	39.6%	40.4%	38.0%

V. Conclusions and Next Steps

The 1999 Provincial Learning Assessment produced a number of insights with respect to Saskatchewan students' opportunity-to-learn and performance outcomes within technological literacy. Specifically, the performance outcome findings revealed:

- Students do understand, define and describe technology well;
- Students need some work in identifying, discussing and making responsible decisions related to technology and society;
- Students need some improvement in reading instructions to use, build and problem solve with technology; and,
- Students need significant improvement in accessing, processing and communicating information.

Challenges lie ahead to facilitate student learning in all aspects of technological literacy. Responsibility for this is shared by students, teachers, parents and all education partners.

Addressing these challenges begins with the awareness and discussion of them. Concerted and dedicated efforts are required by many to bring curricula initiatives to life in the classroom. Students must be given the opportunity to engage in meaningful learning activities, which effectively use technology and raise issues surrounding technology, society and the environment.

Students must come to class ready and committed to learn. This includes a commitment to stay on-task, a persistence to do their best, and a responsibility to do necessary amounts of homework to integrate and apply concepts and to extend classroom learning.

Parents and teachers need to discuss with and help students in the development of these characteristics and the understanding of technological literacy. It is important that lines of communication between students, parents and teachers are open. This includes both formally scheduled conferences and informal discussions and notes.

There is a strong relationship between students' attitudes and their achievement. By becoming active learners in a variety of settings, many students will enjoy learning with and about technology and its impact. As a result, students will further their technological literacy.

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Appendix A: Sample Size and Profile

Participating schools were randomly selected from the list of provincial schools teaching the Saskatchewan curriculum with Grade 5, 8, and 11 students. Selection criteria produced a random sample that proportionally represented rural, urban, and northern schools. Schools of varying population were represented. Criteria excluded selection of schools in the *Division scolaires francophone*.

A school participated in only one component of the *1999 Provincial Technological Literacy Learning Assessment*. For both the performance-based component and written component, a grade population of at least ten students was required.

Students enrolled in regular English Language Arts programs were asked to participate. The purpose of using English Language Arts classrooms was to give the best representation of a typical student at that grade level, since all regular students enroll in English Language Arts classes..

Students in modified programs, where foundational objectives of the course were altered, did not participate. In other words, students in special resource room programs, International Baccalaureate (I.B.) programs, or in locally-developed courses were not assessed. Regular program students requiring adaptations such as Braille, large-print, or scribes participated.

Figure 42 details the sample profile. The sample size permits reliable generalizations of results to the entire Saskatchewan student population sampled for the three grades.

Figure 42: School and Student Participation in the Assessment

PARTICIPATION	Grade 5		Grade 8		Grade 11	
	Written	Performance	Written	Performance	Written	Performance
Total Schools Registered in Sample	31	32	29	32	29	29
Total Schools Participating in Assessment	31	31	28	31	29	29
Participation Rate of Schools	100%	97%	97%	97%	100%	100%
Total Students Registered in Sample	659	620	611	640	658	629
Total Students Participating in Assessment	611	564	581	573	620	539
Participation Rate of Students	93%	91%	95%	90%	94%	86%

Appendix B: Administrative Methods and Procedures

Selected schools and their school divisions were contacted in June 1999. An information bulletin and web site information was available to the public describing the nature and scope of the assessment. Each school chose a coordinator to administer and return assessment materials. A practice performance station with materials and instructions was included for all grades doing the performance-based test. The station prepared students and teachers for this type of an assessment. Scoring rubrics and a list of possible topics were included for the students who were to complete the student submission.

In early October 1999, the *Handbook for School Coordinators* along with all test booklets and performance-based materials were sent to the school coordinators. In addition, a student and teacher video outlining the structure and tasks was included in the package. The videos and the *Handbook for School Coordinators* served to:

- ensure the security of assessment instruments;
- prepare students for the assessment;
- allow for adaptations such as large-print forms, scribes or other special needs;
- set up the performance-station testing-room;
- provide instructions for the completion of questionnaires and assessment forms;
- ensure consistent administration of the tests related to time, breaks, independent student work, and the type of assistance they could give; and,
- ensure student work is properly handled to guarantee student, teacher, school, and school division anonymity.

The assessment was administered between November 1st and November 30th. School coordinators returned all test booklet materials for scoring, but kept the performance station materials for future use.

Appendix C: Scoring and Data Analysis

In April 2000, forty-five teachers and consultants, working in nine supervised teams, scored student work. Three teams scored Grade 5 booklets, three teams scored Grade 8 booklets, and three teams scored Grade 11 booklets. These teachers were selected to reflect the diverse school situations in the province, including urban, rural, and northern locations.

The scorers assessed work completed in the performance station booklets, open-response booklets and student submissions. They analytically scored and determined one of *Levels 1* through *5* for each performance station and Dimensions 1, 2 and 3. To facilitate fair and reliable scoring, the following procedures were used for each item scored.

- Scorers studied the criteria that defined each of the five achievement levels. They examined the tests to see how the items reflected the criteria.
- Examples of student work (exemplars) showing proficiency at each achievement level were chosen and used to serve as references for scorers.
- Training sessions using the criteria, exemplars, and practice booklets developed consistency for judging student work.
- Scoring leaders continually monitored the process for consistency and provided adjudication when necessary.
- About 20% of the booklets were scored twice. The comparative scores were analyzed for team scoring consistency.
- Scorers coded achievement levels on computer scan sheets. Consequently, re-scoring of the booklet and scoring of other elements of the student's work were not prejudiced by the first issued score.

Scoring teams first scored the performance station booklets. For all stations students received a minimum score of Level 1 unless it was not attempted. After scoring all student booklets for one station, scorers were trained to score the next station.

Overall on the performance stations, the Grade 5, 8 and 11 scoring teams had an average Pearson's R inter-scorer reliability of between 0.75 and 0.80. Figure 43 categorizes the inter-scorer reliabilities for Sample B. Generally, scoring reliability was highest when scoring the computer stations and lowest when scoring the design and planning station.

Figure 43: Pearson's R Inter-Scorer Reliability for Sample B

Performance Station Booklet	*Grade 5*	*Grade 8*	*Grade 11*
Word Processing	*0.85*	*0.89*	*0.62*
The Internet	*0.95*	*0.87*	*0.86*
Using a Product of Technology	*0.75*	*0.71*	*0.75*
Design and Planning	*0.61*	*0.68*	*0.72*
Building Models of Technology	*0.75*	*0.75*	*0.68*

After completing the performance station booklets, Dimension 1 and 3 were scored using student responses from the open-response booklets. Students who left more than two-thirds of the responses blank were deemed missing and were recorded as such. Again, all students who completed the booklets received a minimum score of *Level 1*.

Finally, the student submissions were scored using analytical methods of scoring. Students were given a level of attainment for each of the threads of Dimension 2. These include accessing information, processing information and communicating information.

Overall for Sample A, the Grade 5, 8 and 11 scoring teams had an average Pearson's inter-scorer reliability of between 0.70 and 0.75. Figure 44 shows the inter-scorer reliabilities for Dimensions 1, 2 and 3. Generally, the highest scoring reliability occurred when scoring Dimension 2.

Figure 44: Pearson's R Inter-Scorer Reliability for Sample A

Open-Response Booklet	*Grade 5*	*Grade 8*	*Grade 11*
✓ *Dimension 1*	*0.71*	*0.62*	*0.75*
✓ *Dimension 3*	*0.69*	*0.77*	*0.70*
Student Submission			
✓ *Dimension 2*	*0.77*	*0.81*	*0.81*

For student performance in Dimension 1 and Dimension 3, students' higher scores from either the closed- or open-response test were used for reporting purposes. The chart below shows what percent of students scored higher or the same on the two different tests for Dimension 1 and Dimension 3. (See Chapter 3 for more details about the open- and closed-response tests.)

Figure 45: High Score Comparison Results for Dimension 1 and Dimension 3

Dimension 1	*Percent of Students with Closed-Response Test as High Scores*	*Percent of Students with Same Score on Both Tests*	*Percent of Students with Open-Response Test as High Scores*
Grade 5	*53.4%*	*30.0%*	*16.6%*
Grade 8	*42.0%*	*36.0%*	*22.0%*
Grade 11	*21.1%*	*28.4%*	*50.5%*
Dimension 3			
Grade 5	*44.0%*	*33.3%*	*22.7%*
Grade 8	*50.4%*	*37.1%*	*12.5%*
Grade 11	*38.3%*	*41.0%*	*20.6%*

Scorers were asked to guard against bias for unattractive handwriting, incorrect grammar, poor spelling, and any factors other than the communication of the ideas that addressed the questions being presented in the open-response test booklets. However, when student submissions were examined, the scorers were asked to specifically look at how students processed and presented their content.

The coded computer sheets for all items were scanned into a statistical database. Student multiple-choice responses and questionnaire data were all entered into the database. Teacher questionnaire data were also entered.

Item and test analyses were performed for each questionnaire and assessment form. Response patterns, item difficulty, discrimination indices, average scores, frequency distributions, and measures of test reliability were computed. Cross-tabulations and tests for significant variations were done for some test and questionnaire variables.

Appendix D: Standard-Setting Procedures

Standard-setting involves setting standards and stating expectations for opportunity to learn elements, as well as stating expectations for provincial student achievement for a specific set of tests. Standards or expectations are not fixed or static. Expectations will vary according to the complexity of the test questions and tasks, the criteria used for scoring the test, the attributes of the student population being tested, and the composition of the committee setting the standards.

The standards serve to place an interpretive framework around the data, to highlight the strengths and weaknesses in student achievement, and allow the public to confidently judge the adequacy of the assessment results. Such standards have been established for previous provincial reading, writing, and mathematics assessments and for national reading, writing, science and mathematics assessments. The standards remain in place for discussion and comparison with the results until new standards are set to accompany the next cycle in the assessment.

Stakeholder representatives convened to establish both opportunity-to-learn standards and expectations and student achievement expectations.

Who set the standards?

Thirty-one stakeholder representatives sat as three panels of judges to set standards. A separate panel set achievement and opportunity-to-learn standards for each of the three grades participating. Stakeholders that participated represented:

- Saskatchewan Teachers' Federation;
- Saskatchewan School Trustees Association;
- League of Educational Administrators, Directors, and Superintendents;
- Saskatchewan Association of School Councils (parents and students);
- Saskatchewan Chamber of Commerce;
- Saskatchewan Education;
- University of Saskatchewan, Faculty of Education;
- Gabriel Dumont Institute; and,
- Saskatchewan Institute of Applied Sciences and Technology.

In what areas were standards set for student achievement?

Panels first set achievement standards by realistically considering the percentage of students they would expect to attain each of the achievement *Levels 1* through *5* for the following:

- overall achievement for Grade 5, 8, and 11 for each of five performance stations; and
- overall achievement for Grade 5, 8, and 11 for Dimensions 1, 2 and 3.

What process was used to set the standards?

Panelists set achievement and opportunity-to-learn standards using a three-round voting process. Panelists:

- reviewed test instruments, criteria, student exemplars, or background documents to better understand the context of the standards question;
- made initial judgments for the question using private ballots;
- discussed differences in their judgments after viewing the voting-distribution pattern of the panel;
- made second-round, private judgments for the same question considering elements of the discussion;
- viewed a comparison of their second-round voting pattern with actual student outcomes or practices and discussed factors that may explain any differences; and,
- made their final third-round, private judgments for the same question.

The average of the panelists' third round judgement became the standard for that particular question. The process was repeated for the next achievement- or opportunity-to-learn-standard question.

Appendix E: Technological Literacy Assessment Criteria

For this assessment, student achievement was classified into one of five levels. Below are ***some*** characteristics and practices of students achieving the different levels for each dimension of technological literacy. The criteria represents a contemporary view of technology and are consistent with the objectives outlined for the Technological Literacy Common Essential Learning. Not every characteristic needs to be present to identify a student at a given achievement level.

Dimension 1: *Understanding, Describing and Adapting Technology*

Level 5	Student has broad categorization of technology providing strong contrasting examples. Their definition of technology is sophisticated and includes 3 criteria. Students provide a reason(s) for developing technology, they identify that technology is man-made and that technology is a process. They explain in detail the operation and features of a technological product. They consider functional and related limitations of a technology and suggests specific ways of how the product could be improved.
Level 4	Student has large categorization of technology providing some contrasting examples. Their definition of technology is broad, but only includes 2 criteria from the *Level 5* criteria outlined. They explain in some detail the operation and features of a technological product. They consider functional and related limitations of a technology and suggests a general idea of how the product could be improved.
Level 3	Student identifies technology that affects a few areas of life or society. Their definition of technology is general and includes only 1 criteria from the *Level 5* criteria outlined. They generally explain the operation and features of a technological product. They consider a functional limitation for a technology, but have no suggestions on how the product could be improved.
Level 2	Student identifies a number of general examples of technology. Their definition of technology is vague and only references examples to define it. They describe some features of a technological product and considers only related limitations for the product.
Level 1	Student identifies a couple general examples of technology. They state no clear definition of technology.

Level 5	Student identifies and uses a number of different media forms to access information. The information used appears to be reliable. Topics chosen are significant or original. Support is sophisticated and detailed. Information is clearly, thoughtfully and creatively organized. Sophisticated and aesthetically pleasing presentation with effective use of most of the following elements. These elements include purpose of medium; audience needs and interests; aesthetic appeal; appropriateness of graphics; fonts and special effects; correctness of mechanics (spelling, punctuation, capitalization and grammar); clarity of presentation; lack of visual clutter; legibility; and neatness.
Level 4	Student identifies and uses at least 3 different sources and media forms to access information. The information used appears to be reliable. Full support is given to a thoughtfully chosen topic, or an assigned topic is given thoughtful treatment. Transitions / relationships clarify effective organizational pattern of material. Attention to many of the elements listed in the *Level 5* criteria above is included, giving a careful and thoughtful impression. Few errors seldom distract the reader/viewer.
Level 3	Student identifies and uses at least 3 different sources from 2 media forms to access information. Reasonable support is given for a usual topic. There may be some holes in the information, but a generally complete picture is given. Information is organized through a common formula. Clear presentation through attention to some of the elements listed in the *Level 5* criteria above is included. Some errors may detract from the overall intended effect.
Level 2	Identifies and uses at least 2 sources of information. Fragmentary, uneven and disorganized support is given for a common topic. A listing of details or facts betrays a lack of attention to an effective organizing principle. Attention to 1 or 2 of the elements listed in the *Level 5* criteria above is included, leaving the impression that the student is at minimal level of mastery. Many errors distract and annoy audience.
Level 1	Only 1 source of information can be determined. Topic chosen is common and banal. Support is superficial, fragmentary or confusing. Information is minimal and disorganized. Little or no awareness of purpose and effects of technology chosen as reflected in elements listed in the *Level 5* criteria above. Errors confuse and require repeated re-readings / re-viewings.

Dimension 3: *Responsible Citizens and Technology*

Level 5	Shows a thoughtful understanding of the impact technology has on them, society and the environment. Identifies four or more influences for a technological development. Can identify and thoughtfully explain major issues related to the risks and benefits of technology. Considers the risks and benefits related to technology issues and then makes decisions with thoughtful support that are consistent. Suggests how society can address these issues proactively.
Level 4	States generalizations, with specific examples, the impact technology has had on them, society and the environment. Identifies three influences for a technological development. Can identify and explain major issues related to the risks and benefits of technology. Considers the risks and benefits related to technology issues and then makes decisions with specific support that are consistent.
Level 3	Provides specific examples of the impact technology has had on them, society or the environment. Identifies two influences for a technological development. Can identify and generally describe major issues related to the risks and benefits of technology. Considers the risks and benefits related to technology issues and then makes decisions with some support that are consistent.
Level 2	Gives superficial statements about the impact technology has had on them, society or the environment. Gives one influence for a technological development. Vaguely identifies issues related to the risks and benefits of technology. Considers the risks and benefits related to technology issues and then gives a decision in more than one word with fragmented or partially unrelated support.
Level 1	Shows little awareness of the impact technology has had on them, society or the environment. Makes a decision about technology issues with no apparent consideration of the risk and benefit factors.

Dimension 4: *Using Technology, Including Computers*

Level 5	Follows instructions and reference booklets to complete complex tasks when using technology. Thoughtfully applies technology towards a situation and shows a sophisticated understanding of the impact of applying this technology. Utilizes many advance features of computer technology to complete tasks and solve problems.
Level 4	Follows instructions and reference booklets to complete a broad range of tasks when using technology. Applies technology towards a situation and shows an understanding of the impact of applying this technology. Utilizes some advance features of computer technology to complete tasks and solve problems.
Level 3	Follows instructions to complete general tasks when using technology. Applies technology towards a situation and shows an awareness of the impact of applying this technology. Utilizes few advance features of computer technology to complete tasks and solve problems.
Level 2	Follows instructions to complete simple tasks when using technology. Applies some technology towards a situation and shows no awareness of the impact of applying this technology. Completes basic tasks with computer technology.
Level 1	Demonstrates minimal skills in using and applying technology to a situation.

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